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IMPROVING THE ALLOCATION OF MONETARY AND NONMONETARY ARMY ENLISTMENT INCENTIVES BY MOS: VALIDATION EFFORTS USING QUARTERS JAN - JUN 1988, UPDATING OF PARAMETER ESTIMATES, AND UPDATING OF PROJECTIONS

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13. ABSTRACT (*Maximum 200 words*) Over the period FY81-FY86, the US Army obtained some 351,000 GSA (GSDG, I-III A Mental Category) recruits, at a total incentive cost (in FY86 dollars) of $1.17 billion; approximately two-thirds of these recruits received a monetary incentive, either the ACF or an EB. Monetary incentives (as well as nonmonetary incentives such as 2 year term, unit of choice, etc.) expand the market and redistribute recruits over the critical MOSs. Currently USAREC spends nearly $150M annually on such incentives.

The level and mix of the incentive needed by MOS is strongly dependent on the GSA quotas needed in the MOS, GSA quotas outside the MOS, non-GSA quotas, the level of other Army resources (recruiters, advertising, military pay, etc.), and the general recruiting environment (unemployment rate, QMA, etc.).

The general thrust of this effort has been to make available to USAREC a user friendly PC program, documented and validated, to aid in allocating enlistment incentives by MOS. It can be used in a budget generation/budget defense mode, as well as in a budget execution mode. It can also help explore the budget impacts of different scenarios, actuarial cost estimates of the ACF, and the usage of guidance counsellor incentives.

The computer models were built using battalion, quarterly level data, including data on the actual numbers of GSA contracts obtained by MOS, by type of incentive, the level of EB given, the mix of terms of service obtained, the recruiting environment present and the levels of other Army recruiting resources expended. Its decision parameters can be continually updated as more experience becomes available. Keywords:

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IMPROVING THE ALLOCATION OF MONETARY AND NONMONETARY ARMY ENLISTMENT INCENTIVES BY MOS:
Validation Efforts Using Quarters January-June 1988, Updating of Parameter Estimates, and Updating of Projections

Prepared for:

The U.S. Army Recruiting Command (USAREC)

September 11, 1989

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DISCLAIMER

The views and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army policy position or decision, unless designated by other documentation.

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ABSTRACT

Over the period FY81-FY86, the U.S. Army obtained some 351,000 GSA (HSDG, TSC I-IIIA mental category) recruits at a total incentive cost (in FY86 dollars) of $1.17 billion; approximately two-thirds of these recruits received a monetary incentive, either the ACF or an EB. Monetary incentives (as well as nonmonetary incentives such as 2-year term, unit of choice, etc.) expand the market and redistribute recruits over the critical MOSs. Currently, USAREC spends nearly $150M annually on such incentives.

The level and mix of the incentives needed by MOS are strongly dependent on the GSA quotas needed in the MOS, GSA quotas outside the MOS, non-GSA quotas, the level of other Army resources (recruiters, advertising, military pay, etc.), and the general recruiting environment (unemployment rate, QMA, etc.).

The general thrust of this effort has been to make available to USAREC a user-friendly PC program, documented and validated, to aid in allocating enlistment incentives by MOS. It can be used in a budget generation/budget defense mode, as well as in a budget execution mode. It can also help explore the budget impacts of different scenarios, actuarial cost estimates of the ACF, and the usage of guidance counselor incentives.

The computer models were built using quarterly battalion-level data, including data on the actual numbers of GSA contracts obtained by MOS, by type of incentive, the level of EB given, the mix of terms of service obtained, the recruiting environment present, and the levels of other Army recruiting resources expended. The decision parameters can be continually updated as more experience becomes available. Finally, the models can be enhanced to deal with the trade-offs between nonmonetary versus monetary incentives, different advertised values of the ACF, size of GSA-eligible population, Reservist requirements, Federal Loan Repayment Program, etc.

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1.0 INTRODUCTION

1.1 Overview

This report represents the final deliverable of a 12-month study begun in late September of 1988. A mid-project report was delivered on May 1, 1989, entitled, "The Optimal Allocation of Army Enlistment Incentives by MOS: Analyses of CY86-CY87 Experience, Impacts of Nonmonetary Guidance Counselor Incentives, and PC Software." Figure 1 is an overview of the software generated, geared to improving the allocation of both nonmonetary and monetary enlistment incentives used by the U.S. Army to attract quality recruits. (Quality refers to those recruits with a so-called GSA designation who have, or will have a high seshool degree diploma and who score above the 50th percentile on the Armed Forces Qualification Tests.) The mathematical foundations, developed in the first phase and extended in the second, are available in the Appendix.[1]

Guidelines as to the level and mix of incentives warranted by MOS becomes especially significant when one realizes that the Army is forced by Congress not to comingle funds earmarked separately for ACF and EB expenditures.[2] Hence, USAREC needs a utilization plan for splitting its incentive funds to achieve the quotas desired, and to do so efficiently.

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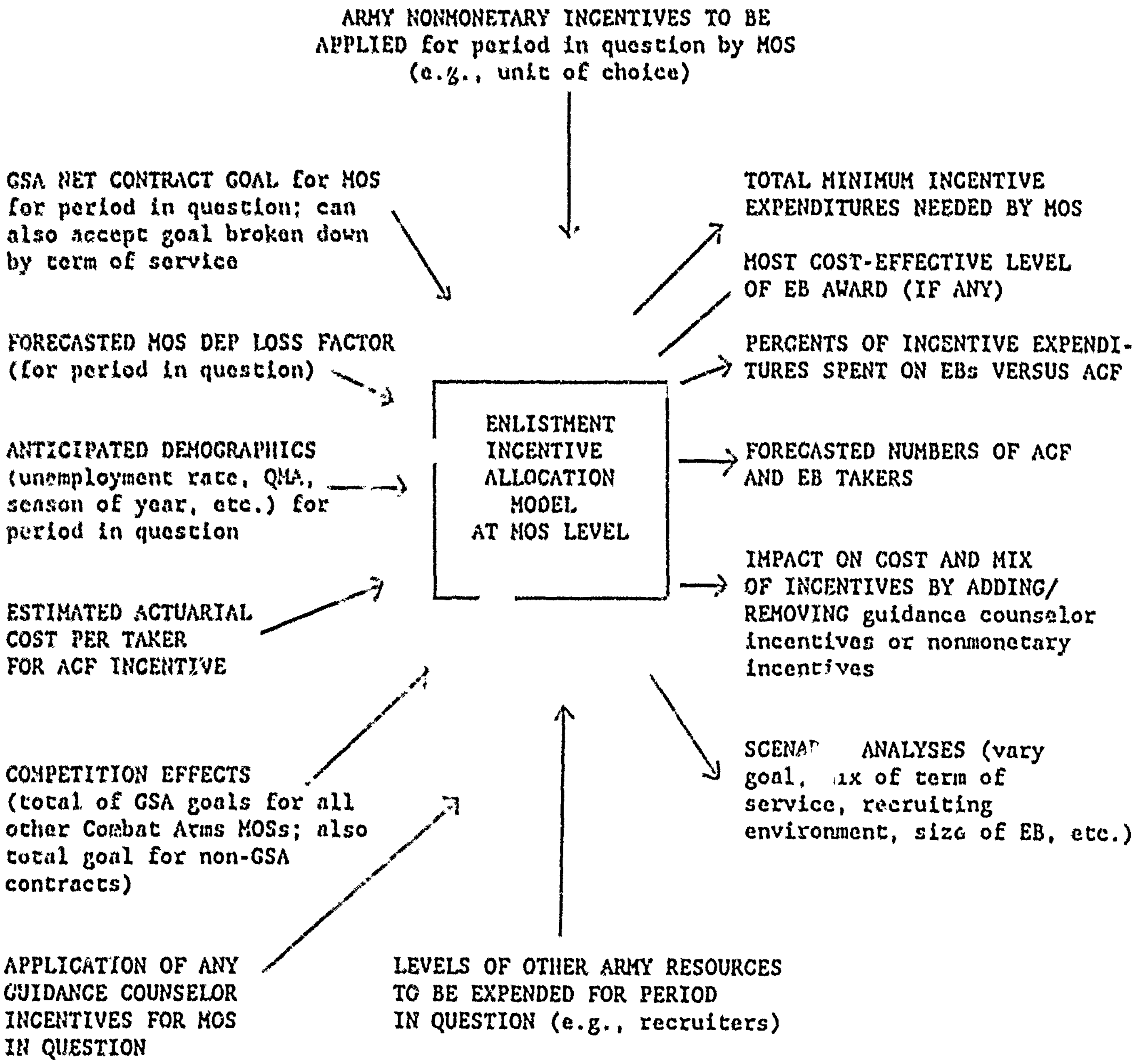
1. See also, Lovel, C.A.K., and Morey, R.C., "The Optimal Allocation of Consumer Incentives: An Application to U.S. Army Recruiting," Management Science (forthcoming).

2. Only $10M can be reprogrammed without congressional approval, a small percentage. Part of the rationale for this noncomingling is due to the distinct roles of the EBs and ACF, whereby the ACF is viewed as a method for expanding the general supply, while the EB is viewed more as a redistribution mechanism (among MOSs). In keeping with this philosophy, the ACF benefit is advertised, but the EB benefit is not.

Figure 1. Inputs and outputs for the Budget Generation and Incentive Mix Allocation Program Related to enlistment incentives by MOS



Discerning the efficient mix by MOS is not an easy task, since the only data available are what has actually been expended; such expenditures may or may not have been cost-effective. Inferring efficient behavior from perhaps inefficient behavior is the key task at hand. The analytic strategy must also deal with the competitive effects associated with simultaneous GSA goal requirements for other MOSs and non-GSA contract goals, as well as the complex recruiting environment. As described in detail in the Appendix, the analysis does this by generating separate estimates of the parameters describing the recruiting technology[3], as well as the parameters describing over- or underutilization of monetary incentives, relative to the cost per unit of using those incentives. It accomplishes this through the use of simultaneous regression modeling, whereby a system of equations is estimated simultaneously to approximate a so-called cost frontier. The statistical programs for accomplishing this are being made available to USAREC as part of the deliverable.

1.2 A Key Purpose of the Second-Half Effort: Validation

One of the major tasks in the second phase of the year-long project has been to "validate" the results of the budget generation model, developed in the first phase of the project. Recall that eight quarters of battalion-level data (from January 1986 to December 1987) were used to build MOS-specific econometric models. Eight different models were built: one for each

3. For example, curvature parameters related to isoquandts.

of six costly Combat Arms MOSs, namely, 11X (Infantry); 12B (Combat Engineer); 13B (Canon Crewman); 13F (Fire Support Specialist); 19D (Cavalry Scout); 19K/19X (Armor Crewman); one for the aggregation of the 23 remaining smaller Combat Arms MOSs; and one for the aggregation of all non-Combat Arms MOSs. These models, in the first phase, were applied to the seventh and eighth quarters and produced very reasonable results on the "within sample" data. However, the real test of the model is to exercise the budget generation model for quarters outside the sample data (on which the model was built) and discern its performance. Hence, one of the thrusts of this second-phase effort has been to exercise individually the eight MOS budget models for the two key quarters of January-March 1988 and April-June 1988, and to compare the projections from the models with what really happened.

By exercising a model, we are referring to the process depicted in figure 1. Note that the user inputs the following factors into each MOS budget model: the distinct numbers of GSA enlistments desired (or actually obtained) for each of the 2-, 3-, and 4-year (or more) terms for the MOS and quarter of interest[4]; the total number of GSA enlistments desired (or actually obtained) in other Combat Arms MOSs for the quarter in question (a competitive factor); the number of non-GSA enlistments desired (or actually obtained) over all MOSs for the quarter in question (a second type of competitive factor); the anticipated (or actual) demographics and recruiting environment expected for the quarter in

4. The ability to deal with this level of detail enables the user to describe quotas in terms of man years (both Active Duty and Reservist) as well as contracts.

question (these are averages for the quarter in question, e.g., the average unemployment rate across all battalions, the average number of recruiters in the field, etc.); the weighted actuarial value of the ACF benefit[5]; whether any nonmonetary benefits will be (or were) available for the MOS in question (e.g., unit of choice); whether or not special guidance question; and the average percentage of the GSA contracts for the MOS in question anticipated to be (or actually were) sold off the first three screens[6]. Given these inputs into each of the eight econometric models, the PC models produce as outputs the following projections:

1. The total efficient incentive cost needed by MOS to meet the given quotas in the environment specified;

2. The efficient level of the EB award[7] by MOS;

3. The efficient split into ACF and EB incentive dollars by MOS;

4. The projected number of ACF and EB takers.

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5. This was based on the DOD actuarial cost estimates, required to be escrowed for each ACF taker, in October 1988. The levels at the time were $2,888 for each 2-year award, $3,750 for each 3-year award, and $3,895 for each 4-year award. Very recently, DOD approved an actuarial cost for each ACF taker at costs substantially lower than the above. See Section 6 for a brief excursion on the impact of such a reduction using the Army Research Institute's estimates of the 2-, 3-, and 4-year ACF costs of $2,672, $1,618, and $1,152 respectively.

6. This represents a second type of guidance counselor incentive.

7. For the validation exercises, the actual level of the average EB award per taker was also an input to the model. The final PC model takes as an input a suggested EB award level for each MOS and then searches in increments and decrements of $500 for the most cost-effective award level, i.e., an EB award level that minimizes the total incentive costs needed for the MOS to meet the desired quotas for the MOS in the recruiting environment postulated.

In the validation phase, the levels of these projected outputs can be compared to the actuals, and a degree of "reasonableness" attached to the models. However, it must be recognized that the models are designed to predict the "efficient" or minimum total incentive costs needed to reach the prespecified levels of GSA contracts desired (or obtained). Hence, using the actual costs as a validating benchmark leaves open the following legitimate possibility: for a given MOS and quarter, the model's predictions and actuals could be different if the incentive allocations actually used for that MOS and quarter were not as cost-effective as possible. If this case occurs (as it does occasionally), it behooves us to understand and rationalize any differences.

1.3 Overview of Results of Validation Exercises

By way of summary, over all Combat Arms MOSs, a total of 9,878 gross GSA contracts were actually obtained over quarters 9 and 10 (January-June 1988) at a total associated incentive expenditure of $25.277M. The exercised models predicted an expenditure of $22.58M (or some 10.7 percent less) for exactly the same levels and mix of GSA contracts (by MOS and term of service), same level of EB award per taker, and same total level of non-GSA contracts. Hence, if the split of EB/ACF allocations had been optimized (and if perfect foresight of the recruiting environment to be contended with had been available), the econometric budget models, built on the previous eight quarters of experience, would have predicted overall about a 10 percent reduction from what was actually spent. Secondly, if the models built on all 10 quarters of data had been used for the projections, the models would have predicted within 2 percent of the total amount actually spent for all MOSs (see table 1 for an overall summary of the validation efforts).

Table 1. Comparison of actual performances with those of projections from 8-quarter and 10-quarter models (same levels and mix of terms for GSA contracts, same recruiting environment, same EB and ACF costs per taker, same nonmonetary incentives in place) (continued on next page)

MOS	Actual Incentive Costs	Projected Incentive Cost Needed from 8-Qtr. Model	Projected Incentive Cost Needed from 10-Qtr. Model	Actual Share of Total Incentive Expenditures Devoted to EB	Projected Share of Total Incentive Expenditures Devoted to EB (from 8-Qtr. Model)	Projected Share of Total Incentive Expenditures Devoted to EB (from 10-Qtr. Model)
11X (Infantry)						
9th Quarter (Jan.'88-Mar.'88)	$ 7.62M	$ 7.39M	$ 8.24M	55%	28%	50%
10th Quarter (Apr. '88-June '88)	$ 6.83M	$ 4.50M	$ 6.05M	66%	29%	55%
Total of 9th and 10th quarters for 11X	$14.45M	$11.89M	$14.29M (98.9% of actual)	60.2%	28.4%	52.1%
32B (Canon Crewman)						
9th Quarter	$ 1.94M	$ 2.44M	$ 2.17M	48%	39%	55.7%
10th Quarter	$ 1.20M	$ 1.05M	$ 1.21M	40%	35%	52.8%
Total of 9th and 10th quarters for 13B	$ 3.14M	$ 3.48M	$ 3.38M (107.6% of actual)	44.9%	37.9%	54.7%
13F (Fire Support Specialist)						
9th Quarter	$ .498M	$ .407M	$ .405M	35%	17%	5.8%
10th Quarter	$ .814M	$ .589M	$ .597M	36%	21%	8.9%
Total of 9th and 10th quarters for 13F	$ 1.312M	$ .996M	$ 1.002M (76.4% of actual)	35.8%	20%	7.6%

Table .. (continued)

MOS	Actual Incentive Costs	Projected Incentive Cost Needed from 8-Qtr. Model	Projected Incentive Cost Needed from 10-Qtr. Model	Actual Share of Total Incentive Expenditures Devoted to EB	Projected Share of Total Incentive Expenditures Devoted to EB (from 8-Qtr. Model)	Projected Share of Total Incentive Expenditures Devoted to EB (from 10-Qtr. Model)
19K/19X (Armor Crewman)						
9th Quarter	$ 1.662M	$ 1.663M	$ 1.678M	43%	45%	48%
10th Quarter	$ 1.333M	$ 1.189M	$ 1.287M	36%	47%	49.2%
Total of 9th and 10th quarters for 19K/19X	$ 2.995M	$ 2.852M	$ 2.965M (99% of actual)	39.8%	45.3%	48.2%
The Aggregate of All Remaining Combat Arms MOSs (including 12B and 19D)						
9th Quarter	$ 1.545M	$ 1.99M	$ 1.676M	25%	3%	18.9%
10th Quarter	$ 1.834M	$ 1.365M	$ 1.548M	31%	14%	28.3%
Total for 9th and 10th quarters for remaining Combat Arms MOSs	$ 3.379M	$ 3.355M	$ 3.224M (95.4% of actual)	28.2%	7.5%	23.4%
The Aggregate of all non-Combat Arms MOSs						
9th Quarter	$11.525M	$15.989M	$12.038M	37%	19%	31.4%
10th Quarter	$ 9.372M	$ 9.395M	$ 8.364M	34%	18%	31.6%
Total of 9th and 10th quarters for all Non-Combat Arms MOSs	$20.897M	$25.384M	$20.402M (97.6% of actual)	35.7%	19%	31.5%

Table 1. (concluded)

MOS	Actual Incentive Costs	Projected Incentive Cost Needed from 8-Qtr. Model	Projected Incentive Cost Needed from 10-Qtr. Model	Actual Share of Total Incentive Expenditures Devoted to EB	Projected Share of Total Incentive Expenditures Devoted to EB (from 8-Qtr. Model)	Projected Share of Total Incentive Expenditures Devoted to EB (from 10-Qtr. Model)
All MOSs						
9th Quarter	$24.79M	$29.879M	$26.207M	43%	22.4%	39.1%
10th Quarter	$21.38M	$18.088M	$19.056M	44.5%	24.7%	40.1%
Total of 9th and 10th quarters for all MOSs	$46.173M	$47.962M	$45.263M (98% of actual)	43.7%	23.3%	39.5%

It is felt that these overall projections render the models quite credible. For the few instances where the eight-quarter budget models predicted considerable less than what was spent, we have argued that the actual expenditures in that quarter were not as cost-effective as possible, had the Army had perfect foresight of the environment to be dealt with.

1.4 Report Organization

A second thrust of the effort since May 1989 has been to reestimate the parameters used in the Budget Generation Software, based on 10 quarters of data rather than the eight used in the first phase. The new estimated parameters are, in general, quite close to the earlier ones, demonstrating the general stability of the estimation procedure. The new Budget Generation Software, together with documentation and the computer programs so USAREC can continue such updating, constitute the final deliverables.

The remainder of this final report is organized as follows. Section 2.0 presents an overview of the actual situation for the new quarters 9 and 10, by MOS, and compares the actual outcomes with the actual outcomes one year and two years earlier. This type of informmation is of interest in attempting to assess whether the actual expenditures in quarters 9 and 10 were reasonable in light of the many changes taking place. Section 3 deals with the validation results, and Section 4.0 with the updating of the models' parameters, based on a merging of all 10 quarters of data. Section 4.0 also contains the new set of projections for quarters 9 and 10 using the updated parameters from all 10 quarters of data. (These are the parameters in the final software delivered to USAREC on August 31, 1989.)

Section 5.0 is an illustration of how the budget program can be used to determine the proper level of the EB award for a given MOS, given the quotas needed and the anticipated recruiting environment. Section 6.0 is a preliminary excursion projecting, for MOS 11X, the possible impacts of reduced actuarial cost estimates for the ACF incentives. However, we must caution that the projections utilize inputs of ACF actuarial costs per taker that are far different from the ones used to build the models; hence, any projections must be viewed with care. If it is desired to use the models in the context of the recently approved (by DOD) ACF actuarial costs, the models should be reestimated. Section 7.0 lists other enhancements to the models that might be considered. The Appendix contains the mathematical development of the model.

2.0 OVERVIEW OF SITUATION FOR 9TH AND 10 QUARTERS

2.1 Comparison of Actuals with Those of One Year and Two Years Earlier

Before getting into the validation itself, it is insightful to compare the actuals for each MOS for the 9th and 10th quarters with the actuals for the same key demographics, recruiting resources, and contract attainments for the eight MOS groups. Table 2 covers the situations for the 9th, 5th, and 1st quarters (i.e., the January-March time period); table 3 for the 10th, 6th, and 2nd quarters (i.e., the April-June time period). All contract totals are for gross contracts, unnetted for attrition in the Delayed Entry Program[8]. This attrition

8. The use of gross contracts by the analysts (agreed upon by USAREC) was necessitated by the manner in which DEP attrition is handled in the Army records. For example, a contract signed in January but attriting in July actually decrements the contract total in July rather than in January. The final Budget Program can estimate the incentive cost needed by MOS to arrive at a given number of net contracts, by factoring the desired net contracts by the forecasted DEP attrition rate to arrive at the needed gross contracts for the MOS in question. See the User Manual for details.

Table 2. Comparison of GSA contract experience and environment for 9th quarter (Jan.-Mar. 1988) with that for Jan.-Mar. 1987 and Jan.-Mar. 1986 (continued)

	Jan.-Mar. 1988 (Quarter 9)	Jan.-Mar. 1987 (Quarter 5)	Jan.-Mar. 1986* (Quarter 1)
1) Actual average unemployment rate	6.66%	7.35%	7.76%
2) Actual number of recruiters	5,206	4,935	4,745
3) Actual size of QMA	9.433M	9.633M	9.807M
4) Actual total number of non-GSA contracts obtained	12,137	13,161	14,500
5) Actual total number of GSA contracts obtained			
a) in 11X (Infantry)	2,807	2,752	1,878
b) Average cost/GSA recruit in 11X	$2,703	$2,750	$3,923
6) Actual total GSA contracts obtained			
a) in 12B (Combat Engineer)	177	192	267
b) Average incentive cost/GSA recruit in 12B	$ 0	$2,405	$3,277
7) Actual total GSA contracts obtained			
a) in 13B (Canon Crewman)	669	605	807
b) Average incentive cost/recruit in 13B	$2,944	$3,293	$5,316
8) Actual total GSA contracts obtained			
a) in 13F (Fire Support Specialist)	189	344	209
b) Average incentive cost/recruit in 13F	$2,765	$2,763	$3,174

* This is the first quarter after delinkage, whereby the recruit could no longer receive both an EB and an ACF award.

Table 2. (concluded)

	Jan.-Mar. 1988 (Quarter 9)	Jan.-Mar. 1987 (Quarter 5)	Jan.-Mar. 1986 (Quarter 1)
9) Actual total GSA contracts obtained			
a) in 19D (Cavalry Scout)	123	123	431
b) Average incentive cost/recruit in 19D	$ 0	$2,733	$3,442
10) Actual total GSA contracts obtained			
a) in 19K/19X (Armor Crewman)	544	341	337
b) Average incentive cost/recruit in 19K/19X	$3,038	$2,383	$5,347
11) Actual total GSA contracts obtained			
a) in all other Combat Arms MOSs	932	1,134	735
b) Average incentive cost/recruit in all other Combat Arms MOSs	$1,640	$2,403	$3,238
12) Actual total GSA contracts obtained			
a) in all non-Combat Arms MOSs	11,835	13,941	15,542
b) Average incentive cost/recruit for all non-Combat Arms MOSs	$ 958	$1,224	$2,184
13) a) Actual Total GSA contracts over all MOSs	17,276	19,432	20,206
b) Total incentive cost over all MOSs	$24.599M	$31.499M	$52.805M
c) Average incentive cost per GSA contract over all MOSs	$1,424	$1,621	$2,613

Table 3. Comparison of GSA contract experience and environment for 10th quarter (Apr.-June 1988) with that for Apr.-June 1987 and Apr.-June 1986 (continued)

	Apr.-June 1988 (Quarter 10)	Apr.-June 1987 (Quarter 6)	Apr.-June 1986 (Quarter 2)
1) Average unemployment rate	5.54%	6.45%	7.27%
2) # of recruiters present	5,163	4,980	4,696
3) Size of QMA	9.363M	9.4M	9.807M
4) Total number of non-GSA recruits	10,849	11,692	12,595
5) Total GSA contracts			
a) in 11X (Infantry)	2,329	2,860	2,428
b) Average cost/GSA recruit in 11X	$2,924	$2,298	$3,869
6) Total GSA contracts			
a) in 12B (Combat Engineer)	154	261	304
b) Average incentive cost/GSA recruit in 12B	$ 0	$2,368	$3,091
7) Total GSA contracts			
a) in 13B (Canon Crewman)	386	552	485
b) Average incentive cost/recruit in 13B	$3,096	$2,663	$5,183
8) Total GSA contracts			
a) in 13F (Fire Support Specialist)	289	293	78
b) Average incentive cost/recruit in 13F	$2,831	$2,615	$3,489

Table 3. (concluded)

	Apr.-June 1988 (Quarter 10)	Apr.-June 1987 (Quarter 6)	Apr.-June 1986 (Quarter 2)
9) Total GSA contracts			
a) in 19D (Cavalry Scout)	67	314	173
b) Average incentive cost/recruit in 19D	$ 0	$2,733	$2,305
10) Total GSA contracts			
a) in 19K/19X (Armor Crewman)	421	213	202
b) Average incentive cost/recruit in 19K/19X	$3,165	$2,304	$3,793
11) Total GSA contracts			
a) in other Combat Arms MOSs	788	764	717
b) Average incentive cost/recruit in other Combat Arms MOSs	$2,272	$1,810	$3,128
12) Total GSA contrects			
a) in all non-Combat Arms MOSs	9,736	11,538	14,170
b) Average incentive cost/recruit in all non-Combat Arms MOSs	$ 923	$ 967	$ 1,990
13) a) Total GSA contracts over all MOSs	14,170	16,795	18,557
b) Total incentive cost over all MOSs	$20.931M	$23.315M	$44.854M
c) Average incentive cost per GSA contract over all MOSs	$1,477	$1,388	$2,417

averaged 7.33 percent over all MOSs for CY86-CY87.

As an example of the types of insights available, note that for January-March, 1988 (table 2) the average incentive cost per GSA contract over all MOSs was $1,424, down nearly $1,200 from that of two years earlier. The same order of savings applies for the April-June 1988 period (table 3), these savings no doubt being possible due to the use of guidance counselor incentives and other nonmonetary mechanisms. Next, compare in detail the situation for 11X for quarter 10 (April-June 1988) with that of just one year earlier (table 3). Note that in spite of the substantially smaller total number of GSA contracts obtained in 11X in the 10th quarter relative to the 6th quarter (April-June 1987)--i.e., 2,329 compared to 2,860 (a 19 percent drop--the average incentive cost per GSA contract in 11X is up about 27 percent. This is in spite of a smaller total number of GSA contracts over all MOSs in the 10th quarter (i.e., 14,170 versus 16,795), and a smaller total number of non-GSA contracts (10,849 versus 11,692). Also, in the 10th quarter there were 183 percent (3.7%) more recruiters present. On the other hand, the somewhat more difficult recruiting environment included a 0.9 percent drop in the unemployment rate and a slightly smaller total QMA. Note that this same phenomenon of lower GSA contract totals but higher average incentive cost per GSA contract also occurred for 13B (Canon Crewman) and for 13F (Fire Support Specialist). While the total number is about the same for the grouping of smaller Combat Arms MOSs, (i.e., 788 GSA contracts in quarter 10 compared to 764 in quarter 6), the average incentive cost per GSA contract is up over 25 percent from the level in quarter 6. Note, on the other hand, that the average incentive cost per GSA contract is much smaller between quarter 10 and quarter 6 for MOSs 12B and 19D, no doubt due in part to the drastically reduced levels of GSA contracts needed in those MOSs.

Finally, while the average incentive cost for 19K/19X, is up dramatically (from $2,304 to $3,165), the number of GSA contracts is also up sharply in the MOS, confirming the expected increasing marginal costs related to incentive usage. We also note for all non-Combat Arms MOSs, that the average incentive was about the same, despite a 16 percent drop in the number of GSA contracts obtained.

These inconsistencies suggest that some of the incentive usage for quarter 10 for selected MOSs may not have been the most cost-effective. The other real possibility is that there may be some missing key demographics that explain the sharp rise in the 10th quarter or that the 0.9 percentage point drop in the unemployment rate is the cause. As an example of the former, the number of GSA-eligible individuals may have dropped sharply over that year. Since information on the size of the GSA-eligible population is not available, this could help explain the differences observed.

Finally, to further exacerbate the evaluation of the relative performance of quarter 10, compare the 9th quarter (January-March 1988) in table 2 with that of a year earlier. For fully seven of the eight MOS groups, the average incentive cost per GSA contract is lower than for a year earlier, the only exception being for 19K/19X, which can be explained because of the sharply higher level of contracts needed between the two quarters. Hence, the unanswered question is: "What happened between the 9th and 10th quarters compared to matched periods a year earlier to give rise to the anomalies observed?" These anomalies will be dealt with further when we compare the projections of the efficient incentive budgets needed for the 10th quarter with that actually spent.

3.0 VALIDATION EXERCISES

3.1 Validation Exercise for MOS 11X, Quarter 9

Consider first the 9th-quarter results. Upon exercising the budget generation model for MOS 11X for the 9th quarter, the model (based on eight quarters) predicted a total incentive cost that was 3 percent less than what was actually spent, a very reasonable level. In the second column of table 4, we see the model would spend 27.8 percent of the total on the EB, compared to the 55.7 percent actually spent. Presumably, the model is recognizing the high cost of the actual average EB award (at $4,105 each) compared to an average cost per ACF award of $3,195.

To help verify the model's recommendation of having less reliance on the EB mechanism at this level of award (i.e., $4,105)), consider the experience over the previous eight quarters on which the model was built, with the EB level ranging from $2,500 to $5,000 (table 5). Note that the fraction of the total incentive dollars spent on the EB for MOS 11X varied drastically by quarter. Table 5 summarizes the actual experience over the 10 quarters.

Table 4. Validation Exercises for MOS 11X (comparison of forecasted with actuals for 9th and 10th quarters) (continued)

Factor	Actuals for Jan.-Mar. 1988 for MOS 11X	Forecasted for Jan.-Mar. 1988 for MOS 11X	Actuals for Apr.-June 1988 for MOS 11X	Forecasted for Apr.-June 1988 for MOS 11X
1) Average local unemployment	6.6595%	Input	5.54%	Input
2) # of recruiters present nationally	5,206	Input	5,163	Input
3) Size of national QMA	9,433,320	Input	9,363,260	Input
4) # of total GSA[1] contracts in MOS 11X broken down as:	2,807	Input	2,329	Input
a) 2 years	696	Input	491	Input
b) 3 years	725	Input	320	Input
c) 4 years (or more)	1,386	Input	1,518	Input
5) # of total Combat Arms GSA contracts outside MOS 11X	14,523	Input	11,794	Input
6) # of total non-GSA contracts obtained over all MOSs	12,137	Input	10,789	Input
7) Average actual[2] level of EB	$4,105	Input	$4,348	Input
8) Average actual[3] value of benefit	$3,195	Input	$3,202	Input

1. These are gross, unnetted contracts; the DEP loss for MOS 11X was about 6.4% in quarter 9 and 4.9% in quarter 10.

2. This is obtained by first taking the total of all EB dollars paid out in the quarter for MOS 11X and dividing by the total number of takers of the EB in that quarter for MOS 11X for each battalion; this is then the average over all battalions.

3. This is obtained by taking the total value of all ACF benefits awarded (using the DOD actuarial estimates) for the 2-, 3-, and 4-year ACF benefit and dividing by the actual total number of takers for the quarter for the MOS.

Table 4. (concluded)

Factor	Actuals for Jan.-Mar. 1988 for MOS 11X	Forecasted for Jan.-Mar. 1988 for MOS 11X	Actuals for Apr.-June 1988 for MOS 11X	Forecasted for Apr.-June 1988 for MOS 11X
9) Unit of choice available sometime in quarter?	Yes	Input	No	Input
10) Did the MOS qualify for special guidance counsellor award?	Yes	Input	Yes	Input
11) The average percent of the contracts for the MOS in question, sold off the first 3 screens	92.98%	Input	98.6%	Input
12) The total value of all incentives	$7.603M	$7.394M (3% less)	$6.830M	$4.499M (34% less)
a) $ for 2-year term	$1.99M	Not generated by model	$1.404M	Not generated by model
b) $ for 3-year term	$2.166M		$1.085M	
c) $ for 4-year or more term	$3.45M		$4.342M	
13) The average fraction spent on the EB	55.7%	27.8%	65.8%	29%
14) Total number of EB takers	1,026	501	1,029	300
15) Total number of ACF awards	1,063	1,670	737	997
16) Total number of ACF or EB takers	2,089	2,171	1,776	1,297
17) Total number of GSA contracts with neither ACF nor EB benefit	718	636	543	1,032
18) Average incentive cost per GSA recruit	$2,703	$2,634	$2,924	$1,932

Table 5. Summary of actual experience for MOS11X over 10 quarters

	Average EB Level	Fraction of Total Incentive Expenditures for 11X Spent on EB	Number of GSA Contracts Obtained in 11X	Avg. Cost/GSA Recruit in 11X
Quarter 1	$4,603	61.1%	1,878	$3,922
Quarter 2	$4,512	61.5%	2,428	$3,869
Quarter 3	$4,929	59.2%	2,496	$4,044
Quarter 4	$3,980	49.5%	2,521	$3,356
Quarter 5	$2,709	33.0%	2,752	$2,750
Quarter 6	$3,500	43.8%	2,860	$2,298
Quarter 7	$3,500	26.5%	2,462	$1,739
Quarter 8	$3,500	28.5%	2,263	$1,916
Quarter 9	$4,105	55.7%	2,807	$2,703
Quarter 10	$4,347	65.8%	2,329	$2,924

Note the wide variation for MOS 11X in average cost/GSA contract, ranging from $4,044 in quarter 3 to $1,739 in quarter 7 (just one year later). Note in these two quarters that the number of GSA contracts obtained in 11X was about the same.

Note that the efficient forecasted fraction of the total incentive expenditures for the EB for the 9th quarter for 11X is 27.8 percent, much closer to the actual experience for the 5th, 7th and 8th quarters. Note, too, that for a similar January-March period a year earlier, i.e., quarter 5, the level of GSA contracts obtained in 11X was about the same, with only 33 percent of the total incentive budget going to the EB side.

Hence, on balance, the projections for quarter 9 for MOS 11X appear quite reasonable. The total projected cost is 3 percent less than actual, the total number of ACF and EB takers is about the same, and the recommended shift towards the ACF side is in keeping with the experience of the recent past.

3.2 Validation Exercise for MOS 11X, Quarter 10

Consider next the same issues for quarter 10, the quarter with the apparent anomaly for 11X raised in Section 2.0. Here, we find a large departure between the projected cost of $4.499M and the actual cost of $6.830M, a drop of 34 percent. We also note that at this level of average EB award (i.e., $4,348), the budget generation model would recommend spending only 29 percent of the total incentive expenditures on the EB mechanism, compared to the 65.8 percent actually spent. To complete the validation process, we must understand why the budget generation model for 11X, predicting cost-effective behavior, is substantially less than what actually happened.

To facilitate this, consider in detail the actual experiences for matched quarters, i.e., those for the 10th quarter and one year earlier, or April-June 1988 and April-June 1987. Consider table 6 which focuses on MOS 11X alone. Then, for quarter 10 relative to quarter 6, we observe the following:

i) From column 1, quarter 10 has far fewer (18.6 percent) total GSA contracts in 11X, but the average GSA contract in 11X is 26 percent more expensive than in quarter 10. This is just the opposite of what one would expect, since the marginal cost per additional GSA recruit in 11X should be at

Table 6. Comparison of environment, outputs, and resources for 11X for quarters 10 and 6

	Total GSA Contracts in 11X	Total 2-year GSA Contracts in 11X	Total 3-year GSA Contracts in 11X	Total 4-yr. or More GSA Contracts in 11X	Total GSA Man Yrs. Obtained	Avg. of EB Award	Unit of Choice Available?	Spec. Guid. Counselor Available for MOS?	% Sold Off First 3 Screens	Unemployment Rate	QMA Available	No. of Recrtrs. Present	Total No. of GSA Contracts Outside MOS 11X	Total No. of non-GSA Contracts over All MOSs
April–June 1987 (quarter 6)	2,860	778	838	1,244	9,046	$3,500	No	Yes	39.8%	6.45%	9.633M	4,989	16,857	11,692
April–June 1988 (quarter 10)	2,329	491	320	1,518	8,014	$4,347	No	Yes	98.6%	5.54%	9.363M	5,163	11,794	10,749

	Actual Average Incentive Cost/GSA Contract	Actual EB Share	No. of 2-yr. ACF Awards	No. of 3-yr. ACF Awards	No. of 4-yr. ACF Awards	No. of 3-yr. EB Awards	No. of 4-yr. EB Awards	Total No. of 2-yr. Terms Not Recvg. ACF nor EB	Total No. of 3-yr. Terms Not Recvg. ACF Or EB	Total No. of 4-yr. Terms Not Recvg. ACF Or EB
April–June 1987 (quarter 6)	$2,298	43.8%	713	251	198	500	315	65 (8.4%)	87 (10.4%)	731 (58.7%)
April–June 1988 (quarter 10)	$2,924	65.8%	486	138	113	162	867	5 (1%)	20 (6.3%)	538 (35.4%)

least nondecreasing. Indeed, the overall cost elasticity on GSA contracts in 11X was previously estimated to be about 2 percent. If this were the case, the 18.6 percent drop in GSA contracts in quarter 10 should be associated with about a 37 percent drop in cost (note that the budget generation model for 11X predicts such a drop in the budget, reflecting the large drop in the quantity of GSA contracts actually obtained). Hence, we have our first indication that the actual expenditures for 11X in quarter 10 might have been excessive.

ii) Could factors related to the environment have legitimately contributed to quarter 10's actual large incentive cost for 11X (compared to the projection)? Compared to quarter 6 (one year earlier), quarter 10 had: nearly 200 more recruiters available than in quarter 6; recruited 1,000 less GSA man years in 11X; had a much easier competitive situation to deal with (i.e., only 11,794 GSA contracts were obtained in Combat Arms MOSs outside 11X in quarter 10 compared to 16,857 in quarter 6); and had much lower total non-GSA contract production (i.e., 10,789 in quarter 10 compared to 11,692 in quarter 6). On the negative side, the unemployment rate was about 0.9 percent less in quarter 10, (i.e., 5.54 percent, down from 6.45 percent) and the QMA available was down about 3 percent. These last two considerations notwithstanding, the 26 percent increase in actual average cost per GSA contract for quarter 10 for 11X (relative to quarter 6) does not appear to be defensible. Indeed, the budget generation model, while adjusting for the more difficult unemployment rate and slightly lower QMA, is basing its projection for quarter 10 to a large degree on the actual experience of a year earlier.

iii) Could differences in guidance counselor practices explain the increased cost in 11X? Indeed, just the opposite appears to be the case. In quarter 10, 98.6 percent of the GSA contracts in 11X were being sold off the first three screens, compared to 39.8 percent a year earlier. If anything, one would expect this mechanism to lower the monetary incentive costs needed.

iv) Finally, in addition to the much lower total GSA contracts obtained in quarter 10 than in quarter 6, we note the very large drop in 2- and 3-year terms, and the increase in the number of 4-year term contracts obtained in quarter 10. While delivering more Active Duty man years, the 4-year (or more) term contracts typically have a much higher portion of individuals who receive neither the ACF nor the EB; (see table 6, last three columns); i.e., they sometimes take the unit of choice (forfeiting any monetary benefit) or are participating in the Federal Loan Repayment Program.) Note that in quarter 6, fully 58.7 percent (731 of the 1,244 4-year GSA contracts) received neither the ACF nor the EB. However, in quarter 10, only 538 (35.4 percent) of the 1,518 GSA, 4-year contracts, received neither the ACF nor the EB benefit. This further suggests that the actual utilization of incentives by 4-year individuals in quarter 10 may have been anomalies compared to the experiences in quarter 6.

Hence, for a variety of reasons, we feel that the efficient budget projection for 11X for quarter 10 is quite intuitive, even though it is some 34 percent lower than what was actually spent.

Having gone through the validation exercise for 11X in some detail, we now present a summary of the validation exercises for all MOSs. Table 7 shows that the actual incentive cost in quarters 9 and 10 over all Combat Arms MOSs to obtain 9,878 total GSA contracts was $25.277M; the total projected amount for this period is $22.58M, or about 10.7 percent less. Further, instead of spending about 50 percent on the EB mechanism, the budget projection (based on the previous eight quarters) would have apportioned only 28.4 percent the balance being for the ACF. Finally, in actuality nearly 73 percent of the Combat Arms GSA contracts received either the ACF or the EB; the budget model predicted a 67.8 percent "take" rate. Part of the difference may be due to the sizes and mixes of the individual quotas (within the aggregate of the smaller Combat Arms MOSs), thereby requiring less use of monetary incentives. The higher budget projected for all non-Combat Arms MOSs than was actually spent is due to the higher assumed "take" rate needed (i.e., 31 percent compared to the actual of 27.1 percent) to obtain the desired number and mix of term. This can similarly be due to a different mix of GSA contracts obtained across the hundreds of non-Combat MOSs in quarter 9 than were obtained over the earlier periods.

4.0 REVISED ECONOMETRIC MODELS, USING ALL 10 QUARTERS OF DATA

4.1 Purpose

Having completed the validation phase (by exercising the econometric models, built on eight quarters of data, on quarters 9 and 10, and by comparing the

Table 7. mary of all validation efforts over quarters 9 and 10 ·.–June 1988) (same recruiting environment, same level and m— of GSA contracts, same average level of EB award per taker, same total number of non-GSA contracts, namely, 22,986) (continued)

	Actual Total (Over 9th & 10th Quarters)	Projected, Efficient (Over 9th & 10th Quarters)
MOS 11X (Infantry)		
Total GSA contracts	5,136	Same
# of 2-year GSA contracts	1,187	Same
# of 3-year GSA contracts	1,045	Same
# of 4-year GSA contracts	2,904	Same
Total incentive cost needed	$14.45M	$11.893M (18.7% less)
Average EB award	$4,225	Same
Average ACF award	$3,198	Same
Fraction spent on EB	60.7%	28.2%
Total number of takers of ACF or EB (percent of total GSA contracts)	3,855 (75.1%)	3,468 (67.5%)
MOS 12B (Combat Engineer)		
Total GSA contracts	331	Same
# of 2-year GSA contracts	3	Same
# of 3-year GSA contracts	82	Same
# of 4-year GSA contracts	248	Same
Total incentive cost needed	$ 0	$ 0
Average EB award	$ 0	Same
Average ACF award	$ 0	Same
Fraction spent on EB	NA*	NA*
Total number of takers of ACF or EB (percent of total GSA contracts)	0 (0%)	0

* NA = not applicable.

Table 7. (continued)

	Actual Total (Over 9th & 10th Quarters)	Projected, Efficient (Over 9th & 10th Quarters)
MOS 13B (Canon Crewman)		
Total GSA contracts	1,055	Same
# of 2-year GSA contracts	336	Same
# of 3-year GSA contracts	341	Same
# of 4-year GSA contracts	378	Same
Total incentive cost needed	$3.139M	$3.483M (10.6% more)*
Average EB award	$3,543	Same
Average ACF award	$3,208	Same
Fraction spent on EB	43.9%	37.7%
Total number of takers of ACF or EB (percent of total GSA contracts)	934 (88.5%)	1,043 (98.9%)
MOS 13F (Fire Support Specialist)		
Total GSA contracts	478	Same
# of 2-year GSA contracts	142	Same
# of 3-year GSA contracts	2	Same
# of 4-year GSA contracts	335	Same
Total incentive cost needed	$1.313M	$.996M (24.2% less)
Average EB award	$3,861	Same
Average ACF award	$3,268	Same
Fraction spent on EB	35.7%	19.4%
Total number of takers of ACF or EB (percent of total GSA contracts)	374 (78.3%)	296 (61.9%)

* In quarter 10, the budget model projected $1.048M, compared to the actual of $1.196M. In quarter 9, the budget model projected $2.435M versus $1.943M actual, because the model projected a need for 723 awards of either the EB or ACF type compared to 571 actual awards

Table 7. (continued)

	Actual Total (Over 9th & 10th Quarters)	Projected, Efficient (Over 9th & 10th Quarters)
MOS 19D (Cavalry Scout)		
Total GSA contracts	190	Same
# of 2-year GSA contracts	0	Same
# of 3-year GSA contracts	0	Same
# of 4-year GSA contracts	190	Same
Total incentive cost needed	$ 0	0
Average EB award	$ 0	Same
Average ACF award	$ 0	Same
Fraction spent on EB	NA*	NA*
Total number of takers of ACF or EB (percent of total GSA contracts)	0 (0%)	0
MOS 19K/19X (Armor Crewman)		
Total GSA contracts	965	Same
# of 2-year GSA contracts	271	Same
# of 3-year GSA contracts	238	Same
# of 4-year GSA contracts	56	Same
Total incentive cost needed	$2.996M	$2.853M (4.8% less)
Average EB award	$3,102	Same
Average ACF award	$3,350	Same
Fraction spent on EB	39.3%	45.8%
Total number of takers of ACF or EB (percent of total GSA contracts)	929 (96.3%)	886 (91.8%)

* NA = not applicable.

Table 7. (continued)

	Actual Total (Over 9th & 10th Quarters)	Projected, Efficient (Over 9th & 10th Quarters)
Other 23 Combat Arms MOS		
Total GSA contracts	1,720	Same
# of 2-year GSA contracts	280	Same
# of 3-year GSA contracts	311	Same
# of 4-year GSA contracts	1,129	Same
Total incentive cost needed	$3.379M	$3.355M (0.8% less)
Average EB award	$2,407	Same
Average ACF award	$3,442	Same
Fraction spent on EB	28.4%	7.2%
Total number of takers of ACF or EB (percent of total GSA contracts)	1,081 (62.8%)	995 (57.8%)
All non-Combat Arms MOSs		
Total GSA contracts	21,571	Same
# of 2-year GSA contracts	1,167	Same
# of 3-year GSA contracts	3,595	Same
# of 4-year GSA contracts	16,809	Same
Total incentive cost needed	$20.897M	$25.383M (21.5% more)*
Average EB award	$3,696	Same
Average ACF award	$3,806	Same
Fraction spent on EB	35.7%	18.6%
Total number of takers of ACF or EB (percent of total GSA contracts)	5,853 (27.1%)	6,689 (31%)

* In quarter 10, the projection was $9.395M, compared to the actual of $9.372M. In quarter 9, the budget model predicted more than what was spent, probably due to a different mix of

Table 7. (concluded)

	Actual Total (Over 9th & 10th Quarters)	Projected, Efficient (Over 9th & 10th Quarters)
Total over all Combat Arms MOSs		
Total GSA contracts	9,878	Same
# of 2-year GSA contracts	2,219	Same
# of 3-year GSA contracts	2,019	Same
# of 4-year GSA contracts	5,640	Same
Total incentive cost needed	$25.277M	$22.58M (10.7% less)
Fraction spent on EB	50.44%	28.4%
Total number of takers of ACF or EB (percent of total GSA contracts)	7,203 (72.9%)	6,688 (67.89%)
All MOSs		
Total GSA contracts	31,449	Same
# of 2-year GSA contracts	3,386	Same
# of 3-year GSA contracts	5,614	Same
# of 4-year GSA contracts	22,449	Same
Total incentive cost needed	$46.174M	$47.963M (3.9% more)
Fraction spent on EB	43.8%	23.2%
Total number of takers of ACF or EB (percent of total GSA contracts)	13,056 (41.5%)	13,377 (42.5%)

forecasted results with the actual results) (see Section 3.0), the next step was to update for each MOS the parameters of the econometric Translog function, using all 10 quarters of data. The new results are shown in tables 8, 10, 12, 14, 16, and 18. Each table has two sets of parameters, one for the total cost equation and one for the EB cost-share equation, the parameters being established simultaneously, using the Seemingly Unrelated Regression Package of SAS. For comparison purposes, the earlier estimated parameters (using eight quarters of data) are also included (see tables 9, 11, 13, 15, 17, and 19).

Note that the reestimation could not be performed for MOS 12B and MOS 19D because no incentives were given for these MOSs for the 9th and 10 quarters (due to the very small quotas). The final regression parameters for 12B and 19D, based on eight quarters of data, are presented in tables 20 and 21, respectively.

4.2 Discussion of Regression Parameter Results for 11X

Consider first a comparison of the results for 11X (tables 8 and 9).

i) To begin with, the key intercept in the EB cost share is about the same, at the level of about .27. The other parameters in the EB cost share equation have roughly the same magnitude and sign.

ii) Additionally, the degree of allocative inefficiency seems to have decreased, i.e., over the eight quarters of data, the econometric model predicted that the EB mechanism was significantly overutilized. This prediction was based on a difference of approximately .23 in the intercept of the EB cost-share equation and the coefficient of the logarithm of the price of the EB (at .042) in the cost equation. When we now merge quarters 9 and

Table 8. MOS 11X regression results-10 qtrs.
total cost

SYSTEM WEIGHTED MSE IS 1.05686 WITH 1049 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS .883736

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0
INTERCEP	0.67007043	0.20431297	3.280
LY1	0.48309595	0.04232395	11.414
LY2	0.33257556	0.2983333	11.148
LY3	0.17547362	0.05554682	3.159
LOTHGSA	-0.0266452	0.03128752	-0.852
LPEB	0.23482885	0.06306044	3.724
LPACF	0.76517115	0.06306044	12.134
LY1SQ	0.14320305	0.01202661	11.907
LY2SQ	0.09140506	0.008823514	10.359
LY3SQ	0.19100066	0.02738772	6.974
LY1Y2	-0.0991912	0.01214626	-8.166
LY1Y3	-0.0871681	0.01894533	-4.601
LY2Y3	-0.0340778	0.01536767	-2.217
LPACFSQ	0.54743450	0.03309226	16.543
LPEBSQ	0.54743450	0.03309226	16.543
LPAPEB	-0.547435	0.03309226	-16.543
LPAY1	0.12977762	0.008321173	15.596
LPAY2	-0.0426344	0.006116476	-6.970
LPAY3	-0.106122	0.01111044	-9.552
LPEBY1	-0.129778	0.008321173	-15.596
LPEBY2	0.04263444	0.006116[illegible]6	6.970
LPEBY3	0.10612181	0.01111044	9.552
LNONGSA	0.004130914	0.0272976	0.151
STATIOND	0.02898258	0.01693149	1.712
UNITD	0.05802056	0.02527549	2.296
LRECRUIT	-0.00157834	0.00860975	-0.183
POINTS	0.15021383	0.03576063	4.201
LQMA	0.02672571	0.03061756	0.873
LUNEMP	0.05018336	0.0246803	2.033
LPCPRES	0.01403589	0.009146256	1.535
QD1	0.27137626	0.02047708	13.253
QD2	0.20488135	0.0199754[illegible]	10.257
QD3	-0.00825122	0.0219[illegible]	-0.376
YRD86	0.47690541	0.030[illegible]	15.507

MOS 11X regression results-10 qtrs.
enlistment bonus cost [illegible]

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0
INTERCEP	0.27158158	0.03023953	8.981
LPACF	-0.547435	0.03309226	-16.543
LPEB	0.54743450	0.03309226	16.543
LY1	-0.129778	0.008321173	-15.596
LY2	0.04263444	0.006116476	6.970
LY3	0.10612181	0.01111044	9.552

Table 9. MOS 11X regression results-8 qtrs.
total cost

SYSTEM WEIGHTED MSE IS 1.017074 WITH 835 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.904013

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.87821120	0.21994976	3.993
LY1	0.46897631	0.4310638	10.880
LY2	0.32552262	0.0391289	8.319
LY3	0.15372507	0.05719741	2.688
LOTHGSA	-0.00608371	0.0332281	-0.018
LPEB	0.04215031	0.1244929	0.339
LPACF	0.95784969	0.12449292	7.694
LY1SQ	0.13287558	0.01200649	11.067
LY2SQ	0.10363877	0.009519558	10.887
LY3SQ	0.11937111	0.2944069	4.055
LY1Y2	-0.121372	0.0185603	-9.441
LY1Y3	-0.0412481	0.02000112	-2.062
LY2Y3	-0.00621761	0.01870701	-0.332
LPACFSQ	0.43610309	0.03840985	11.354
LPEBSQ	0.43610309	0.03840985	11.354
LPAPEB	-0.436103	0.3840985	-11.354
LPAY1	0.11048883	0.009614398	11.492
LPAY2	-0.0700368	0.007619581	-9.192
LPAY3	-0.0700653	0.01329465	-5.270
LPEBY1	-0.110489	0.009614398	-11.492
LPEBY2	0.07003676	0.007619581	9.192
LPEBY3	0.07006534	0.01329465	5.270
LNONGSA	-0.0375201	0.02928012	-1.281
STATIOND	-0.0161682	0.01755424	-0.921
UNITD	0.05010037	0.02679319	1.870
LRECRUIT	-0.00682794	0.008147341	-0.838
POINTS	0.20783087	0.05339555	3.892
LQMA	0.04573874	0.03198417	1.430
LUNEMP	0.0646784	0.02567734	2.519
LPCPRES	-0.00125711	0.008724379	-0.144
QD1	0.27593322	0.3666609	7.526
QD2	0.12758593	0.2247291	5.677
QD3	0.01587246	0.02400725	0.661
YRD	0.49323262	0.3701186	13.326

MOS 11X regression results-8 qtrs.
enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.27275596	0.3440188	7.929
LPACF	-0.436103	0.03840985	-11.354
LPEB	0.43610309	0.03840985	11.354
LY1	-0.110489	0.009614398	-11.492
LY2	0.07003676	0.007619581	9.192
LY3	0.07006534	0.01329465	5.270

10 together with the original eight quarters of data, the difference in the intercept of the EB cost-share equation and the logarithm of the price of the EB in the cost equation is now only .037. This result implies that while the actual EB cost share was 48.4 percent, over the 10 quarters it should have averaged 44.7 percent, or about 3.7 percentage points less, a very credible result.

Consider, too, some of the other insights from the new econometric results for 11X that help to instill "reasonableness" in the estimated parameters.

i) As the number of 3-year termers (denoted Y2 in tables 8 and 9) and 4- year termers (denoted Y3) increase, there is much more reliance on the EB mechanism. Also, as the number of 2-year recruits (Y1) increases, there is much less reliance on the EB (as, of course there should be) since the EB is not available for 2-year recruits.

ii) As the price of the EB award goes up, a larger fraction of the total incentive cost goes towards the EB, due to its higher per unit cost.

iii) As the quotas for any of the three types of contracts increase, the cost increases, as expected.

iv) The total cost increases if the price per unit of the incentives increases.

v) The positive coefficients associated with the squared contracts of each type imply that the cost elasticities, relative to the numbers of contracts required, are increasing, as expected.

vi) As before, the sign on the unit of choice dummy implies that making available the unit of choice for 11X increases total GSA 4-year contract production.

vii) Awarding guidance counselor points increases GSA contract production, as previously found.

viii) An increasing unemployment rate will lead to more GSA contracts, as previously found.

xi) The CY86 dummy is still positive implying that CY86 was more costly than CY87 or CY88, capturing, no doubt, the impact of fuller implementation of guidance counselor reforms.

x) The seasonal dummies reveal the same message, namely: relative to the 4th quarter of the CY, costs are significantly higher in the first and second quarters, after all adjustments.

4.3 Comparison of Estimated Elasticities for 11X (Based on 10 Quarters of Data Relative to 8 Quarters of Data

Consider the revised estimates of the cost elasticities on the quotas for GSA contracts in 11X, based on the 10 quarters of data. The cost elasticity on 2-year GSA contracts (see table 8) by:

$$\frac{d(\ln C)}{d(\ln(\#\text{ of 2-year contracts})} = .483 + (.143)\ln(\#\text{ of 2-year GSA contracts}) - .099\ln(\#\text{ of 3-year GSA contracts}) - .087\ln(\#\text{ of 4-year GSA contracts}) + .130\ln(\text{price of ACF option}) - .13\ln(\text{price of EB option})$$

The quarterly battalion cell means (over 10 quarters) are:

# of 2-year GSA contracts in 11X = 11.67

# of 3-year GSA contracts in 11X = 12.99

# of 4-year GSA contracts in 11X = 21.34

price of ACF option in 11 X = \$3,279

price of EB option in 11X = \$3,968

# of 2-year ACF takers in 11X = 11.23

# of 3-year ACF takers in 11X = 6.15

# of 4-year ACF takers in 11X = 2.73

# of 3-year EB takers in 11X = 5.19

# of 4-year EB takers in 11X = 11.57

Hence, the cost elasticity for 11X on the number of 2-year GSA contracts, evaluated at the 10-quarter cell means, is .29. (1)

Consider next the cost elasticity for 3-year GSA contracts for 11X:

$$\frac{(\ln C)}{d(\ln(\#\text{ of 3-year GSA contracts})} = .33 + (.091)\ln(\#\text{ of 3-year GSA contracts})$$
$$- .099 \ln(\#\text{ of 2-year GSA contracts})$$
$$- .034 \ln(\#\text{ of 4-year GSA contracts})$$
$$- .043 \ln(\text{price of ACF option})$$
$$+\ 043 \ln(\text{price of EB option})$$

Hence, evaluated at the 10-quarter cell means, we obtain .23. (2)

Finally, the cost elasticity for 4-year (or more) GSA contracts is:

$$\frac{d(\ln C)}{d(\ln \text{ \# of 4-year GSA contracts})} = .175 + (.191)\ln(\text{\# of 4-year GSA contracts}) - .087\ln(\text{\# of 2-year GSA contracts}) - .034\,(\ln(\text{\# of 3-year GSA contracts}) - .106\ln(\text{price of ACF option}) + .106\ln(\text{price of EB option})$$

Evaluated at the cell means, we get .48 Hence, keeping the mix unchanged, (3) the overall cost elasticity on the total goal for GSA contracts for 11X is about 1.00 = .29 + .23 + .48. Hence, each 1 percent increase in the overall GSA goal for 11X can be expected to be accompanied by an increase in total incentive expenditures of about 1 percent, so that constant returns to scale operate, given the same levels of other resources.

xii) We also observe, as found previously, that the competition effects from other MOSs were insignificant for 11X.

xiii) Consider the impact of making the unit of choice for 11X on the production of 4-year termers in 11X. (The unit of choice was made available during the 9th quarter but not during the 10th quarter; it was also offered for quarters 1, 2, 3, and 4, but not for quarters 5, 6, 7, and 8.) Then:

$$\frac{d(\ln(\#\text{ of 4-year or more GSA contracts in 11X}))}{d(\text{unit of choice})}$$

$$= \frac{d(\ln(\#\text{ of 4-year or more GSA contracts in 11X}))}{d(\ln(\text{incentive cost}))} \times \frac{d(\ln(\text{incentive cost}))}{d(\text{unit of choice})}$$

$$= \frac{1}{.48} \times .058 = .12.$$ (The first term is the reciprocal of the result in (3).)

Upon exponentiating this, we estimate that making the unit of choice option available for 11X would increase average quarterly, battalion production of GSA 4-year recruits by 1.127. Since the cell means is 21.34, this represents nearly a 5.28 increase due to unit of choice availability for 11X.

xiv) Consider the impact of awarding special guidance counselor points or awards for selling 11X. (This was actually the situation for quarters 9 and 10, as it was for all other quarters except quarter 1.) The relevant calculations are:

$$\frac{d(\ln(\#\text{ of 2-year GSA contracts in 11X}))}{d(\text{application of points})}$$

$$= \frac{d(\ln(\#\text{ of 2-year GSA contracts in 11X}))}{d(\ln(\text{incentive cost}))} \times \frac{d(\ln(\text{incentive cost}))}{d(\text{application of points})}$$

$$= \frac{1}{.29} \times .15 = .517.$$ (The first term is the reciprocal of the result in (1).)

Exponentiating this, we get 1.6677 more 2-year GSA contracts per cell from awarding special quidance counselor points for selling 11X. Continuing, we obtain:

$$\frac{d(\ln \# \text{ of 3-year GSA contracts})}{d(\text{application of points})}$$

$$= \frac{d(\ln(\# \text{ of 3-year GSA contracts in 11X})}{d(\ln(\text{incentive costs})} \times \frac{d(\ln(\text{incentive costs})}{d(\text{application of points})}$$

$= \frac{1}{.23} \times .15$ or upon exponentiating 1.919 more 3-year GSA contracts per cell. (The first term is the reciprocal of (2).)

Finally,

$$\frac{d(\ln(\# \text{ of 4-year GSA contracts in 11X})}{d(\text{appliclation of points})}$$

$$= \frac{d(\ln(\# \text{ of 4-year GSA contracts in 11X})}{(d(\ln(\text{incentive cost})} \times \frac{d(\ln(\text{incentive cost}))}{d(\text{application of points})}$$

$$= \frac{1}{.48} \times .15 = .3125$$

Exponentiating this yields 1.367 more 4-year GSA recruits. Upon adding, we obtain an estimate of 1.677 + 1.919 + 1.367 = 4.963 more GSA contracts per cell, an increase of 9.73%. Hence, it is estimated that putting 11X on the special priority MOS listing (earning guidance counselor awards) increases total GSA contract production in 11X by 9.73 percent.

xv) Finally, consider the elasticity of the size of the EB award for 11X on 4-year GSA contract production. The calculation is:

$$\frac{d(\ln(\#\text{ of 4-year GSA contracts})}{d(\ln(\text{level of EB award})}$$

$$= \frac{d(\ln(\#\text{ of 4-year GSA contracts})}{d(\ln(\text{incentive cost})} \times \frac{d(\ln(\text{incentive cost})}{d(\ln(\text{level of EB award})}$$

The first term has already been seen (see (3)) to be $\frac{1}{.48}$.

Consider the second term:

$$\begin{aligned}\frac{d(\ln(\text{incentive cost})}{d(\ln(\text{level of EB award}))} = {} & .234 + (.547)\ln(\text{level of EB award}) \\ & - .547\ (\ln(\text{price of ACF}) \\ & - .1298\ (\ln(\#\text{ of 2-year GSA contracts}) \\ & + .043\ (\ln(\#\text{ of 3-year GSA contracts}) \\ & + .106\ (\ln(\#\text{ of 4-year GSA contracts})\end{aligned}$$

When evaluated at the overall cell means, one obtains .45 for the above. Therefore, the change in 4-year GSA contract production for 11X associated with a 1 percent change in the level of the EB award is given by:

$$\frac{1}{.48} \times .45 = .938\%$$

Thus, based on 10 quarters of data, we estimate that increases of 1 percent in the level of the EB award for 11X will increase GSA contract production of 4-year termers by about .938 percent (or about another one-tenth of a GSA recruit in 11X per cell).

We also point out that the value of the EB bonus has varied over the 10 quarters from $2,500 to $5,000, with a mean (for 3- and 4-year awards) of $3,968. For quarters 9 and 10, the mean was respectively, $4,105 and $4,347, with the EB cost shares being at 56 percent and 66 percent.

4.4 Comparison of Revised Regression Parameters for Other MOSs

Tables 10, 12, 14, 16, and 18 show the revised econometric parameters, using the complete 10-quarter data set, for MOSs 13B (Canon Crewman), 13F (Fire Support Specialist), 19K/19X (Armor Crewman), the aggregated 23 remaining Combat Arms MOSs, and the aggregated non-Combat Arms MOSs. For comparison sake, the regressions based on eight quarters are presented in tables 11, 13, 15, 17, and 19. The revised parameters are the ones now included in the budget generation software being delivered to USAREC as part of the final product.

As mentioned earlier, the updatings could not be performed for MOS 12B (Combat Engineer) or for MOS 19D (Cavalry Scout) because no EB or unit of choice incentives were utilized during the 9th and 10th quarters for these two MOSs. This was presumably due to the very low numbers of GSA contracts required in these 2 MOSs over the 9th and 10th quarters. To be specific, over the 9th and 10th quarters, the total number of GSA contracts for MOS 12B averaged only 166 per quarter; this is to be compared with an average of 393 GSA contracts over the previous quarters for 12B. For 19D (Cavalry Scout), the actual average of GSA contracts for the 9th and 10th quarters was only 95 per quarter (and all were 4-year or more recruits); in contrast, the previous eight-quarter average was 277 per quarter. For these reasons, no incentives were awarded for these two MOSs. Hence, in the budget generation software for MOSs 12B and 19D, we continue to rely on the estimates from the eight-quarter data set (see tables 20 and 21).

A detailed comparison of the two sets of estimates for 11X has already been completed. The general conclusion was that the results were quite stable, with no drastic changes in sizes and levels of significance. The EB cost-share parameters are particularly unchanged, since it is simply "tracking" the percentage of the incentive expenditures devoted to the EB side. The cost equation parameters are more responsive to changes in policy, the increased impact of the guidance counselor incentives program, etc.

Table 22 presents a comparison of two key estimated parameters for each MOS, one based on the regression results using eight quarters and one based on the regression results using 10 quarters. The two key parameters--namely, the intercept in the EB cost-share equation and the coefficient of the logarithm of the EB price--are used to assess the proper mix of the incentives. The last columns show the change, if any, in the recommended change in the EB cost share from the two sets of regressions.

4.5 Comparison of Actual Performances for January-June 1988 with Projections Using Models Built from All 10 Quarters of Data

Section 3 dealt with comparisons of the actuals for the 9th and 10th quarters (January-June 1988) with the projections from the econometric models built from data covering the eight quarters from January 1986 to December 1987. This constitutes a key part of the validation phase because only the

Table 10. MOS 19X regression results-10 qtrs.
total cost

SYSTEM WEIGHTED MSE IS 1.09644 WITH 1045 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.906867

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.96972248	0.26818567	3.616
LY1	0.26783624	0.01106623	24.203
LY2	0.23904310	0.0110617	21.610
LY3	0.31472788	0.008[illegible]798	36.776
LOTHGSA	0.04990451	0.03850602	1.296
LPEB	0.46727810	0.0878938	5.316
LPACF	0.53272190	0.0878938	6.061
LY1SQ	0.07922072	0.005180976	15.291
LY2SQ	[illegible]17953618	0.005076664	15.667
LY3SQ	0.[illegible]2271784	0.00453675[illegible]	27.050
LY1Y2	-0.0120785	0.001803168	-6.699
LY1Y3	-0.0285549	0.002457283	-11.621
LY2Y3	-0.0337291	0.002520182	-13.384
LPACFSQ	0.51546419	0.02863565	18.001
LPEBSQ	0.51546419	0.02863565	18.001
LPAPEB	-0.515464	0.02863565	-18.001
LPAY1	0.05041756	0.003183859	15.835
LPAY2	-0.0207605	0.004028205	-5.154
LPAY3	-0.0500021	0.005097673	-9.809
LPEBY1	-0.0504176	0.003183859	-15.835
LPEBY2	0.02076052	0.004028205	5.154
LPEBY3	0.05000207	0.005097673	9.809
LNONGSA	0.009720233	0.03578197	0.272
STATIOND	-0.-185741	0.02311173	-0.804
UNITD	0.0653357	0.03001459	2.177
LRECRUIT	-0.00782383	0.01176903	-0.665
POINTS	-[illegible].0292495	0.02914772	-1.003
LQMA	0.01763089	0.03997697	0.441
LUNEMP	0.08312748	0.03379986	2.459
LPCPRES	0.009178518	0.004448094	2.063
QD1	0.05425764	0.02833179	1.915
QD2	0.05854768	0.2974285	1.968
QD3	-0.00463549	0.03213903	-0.144
YRD86	0.15147629	0.05512344	2.748

MOS 10X regression results-10 qtrs.
enlistment bonus cost share

MODEL: EQ[illegible] [illegible]GLS
DEP [illegible]

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.39455912	0.01187605	33.223
LPACF	-0.515464	0.02863565	-18.001
LPEB	0.51546419	0.02863565	18.001
LY1	-0.0504176	0.003183859	-15.835
LY2	0.02076052	0.004028205	5.154
LY3	0.05000207	0.005097673	9.809

Table 11. MOS 13B simultaneous regression results on total cost (8 qtrs.)

SYSTEM WEIGHTED MSE IS 1.07696 WITH 833 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.0917524

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.9736006	0.28155437	3.458
LY1	0.22884390	0.01284535	17.815
LY2	0.22810095	0.01184844	19.252
LY3	0.34050662	0.009154289	37.196
LOTHGSA	0.07238445	0.04073119	1.777
LPEB	0.29157838	0.09586981	3.041
LPACF	0.70842162	0.09586981	7.389
LY1S1	0.06307375	0.005658461	11.147
LY2SQ	0.07743594	0.005457068	14.190
LY3SQ	0.13047971	0.004866933	26.809
LY1Y2	-0.0119109	0.002026708	-5.877
LY1Y3	-0.0234162	0.002669569	-8.772
LY2Y3	-0.0363151	0.002626861	-13.825
LPACFSQ	0.48024404	0.0302805	15.860
LPEBSQ	0.48024404	0.0302805	15.860
LPAPEB	-0.480244	0.0302805	-15.860
LPAY1	0.0489486	0.003340674	14.516
LPAY2	-0.0197324	0.00440498	-4.480
LPAY3	-0.0547746	0.005669941	-9.661
LPEBY1	-0.0484949	0.003340674	-14.516
LPEBY2	0.01973238	0.00440498	4.480
LPEBY3	0.05477463	0.005669941	9.661
LNONGSA	-0.0230186	0.03937763	-0.585
STATIOND	-0.0445353	0.029682	-1.500
UNITD	0.063746[illegible]	0.03458825	1.843
LRECRUIT	-0.00861706	0.01127903	-0.764
POINTS	0.11030996	0.04363191	2.528
LQMA	0.02690531	0.04325941	0.622
LUNEMP	0.0961888	0.03592107	2.678
LPCPRES	0.01687346	0.004795979	3.51[illegible]
QD1	0.15430596	0.03805525	4.05[illegible]
QD2	-0.0688619	0.0390806	-1.76[illegible]
QD3	-0.0876714	0.03524072	-2.488
YRD	0.25060263	0.05988989	4.184

MOS 13B simultaneous regression results on enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.40707933	0.01413198	28.806
LPACF	-0.480244	0.0302805	-15.860
LPEB	0.48024404	0.302805	15.860
LY1	-0.0484949	0.003340674	-14.516
LY2	0.01973238	0.00440498	4.480
LY3	0.05477463	0.005669941	9.661

Table 12. MOS 13F regression results-10 qtrs. total cost

SYSTEM WEIGHTED MSE IS 1.26508 WITH 909 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.799275

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	1.68374427	0.39922801	4.218
LY1	0.36627005	0.01867728	19.610
LY2	0.29100207	0.02123477	13.704
LY3	0.34793860	0.0170877	20.362
LPEB	-0.000443649	0.11182267	-0.004
LPACF	1.00044365	0.11182267	8.947
LY1SQ	0.14236027	0.009211253	15.455
LY2SQ	0.11027082	0.01048145	10.521
LY3SQ	0.12716245	0.008101984	15.695
LY1Y2	-0.0237856	0.002053186	-11.585
LY1Y3	-0.0251233	0.002547025	-9.864
LY2Y3	-0.014207	0.002144706	-6.624
LPACFSQ	0.40455517	0.05988234	6.756
LPEBSQ	0.40455517	0.059988234	6.756
LPAPEB	-0.404555	0.05988234	-6.756
LPAY1	0.06868478	0.00402722	17.055
LPAY2	-0.0103496	0.004041064	-2.561
LPAY3	-0.0593899	0.003971333	-14.955
LPEBY1	-0.0686848	0.00402722	-17.055
LPEBY2	0.01034956	0.004041064	2.561
LPEBY3	0.05938991	0.003971333	14.955
LOTHGSA	-0.0835354	0.05524692	-1.512
LNONGSA	-0.0985987	0.0505321	-1.951
STATIOND	-0.147448	0.04058765	-3.633
UNITD	0.04162882	0.04336405	0.960
LRECRUIT	0.003829769	0.01934717	0.198
POINTS	0.01275649	0.03415891	0.373
LQMA	0.16959399	0.06062761	2.797
LUNEMP	-0.00494336	0.04842198	-0.102
LPCPRES	0.004207352	0.00481149	0.874
QD1	0.03563864	0.03928903	0.907
QD2	-0.00366856	0.04240302	-0.087
QD3	0.05460472	0.03973489	1.374
YRD86	0.14432815	0.04398057	3.282

MOS 13F regression results-10 qtrs.
enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTECEP	0.33638001	0.01332354	25.247
LPACF	-0.404555	0.05988234	-6.756
LPEB	0.40455517	0.05988234	6.756
LY1	-0.0686848	0.00402722	-17.055
LY2	0.01034956	0.004041064	2.561
LY3	0.05938991	0.003971333	14.955

Table 13. MOS 13F simultaneous regression results on total cost (8 qtrs.)

SYSTEM WEIGHTED MSE IS 1.3039 WITH 719 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.823887

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	1.21437539	0.40968743	2.964
LY1	0.35620703	0.01906159	18.687
LY2	0.29986912	0.02040605	14.695
LY3	0.32925234	0.01954471	16.846
LPEB	0.0732105	0.12929473	0.566
LPACF	0.92678950	0.12929473	7.168
LY1SQ	0.13350281	0.009361108	14.261
LY2SQ	0.11220237	0.009928384	11.301
LY3SQ	0.11556907	0.009624144	12.008
LY1Y2	-0.0227077	0.00215493	-10.538
LY1Y3	-0.0226059	0.002442907	-9.254
LY2Y3	-0.0144977	0.002224679	-6.517
LPACFSQ	0.44279977	0.06136391	7.216
LPEBSQ	0.44279977	0.06136391	7.216
LPAPEB	-0.4428	0.06136391	-7.216
LPAY1	0.07003735	0.004076215	17.182
LPAY2	-0.00175124	0.004024402	-0.435
LPAY3	-0.0620148	0.004069471	-15.239
LPEBY1	-0.0700374	0.004076215	-17.182
LPEBY2	0.001751243	0.004024402	0.435
LPEBY3	0.06201481	0.004069471	15.239
LOTHGSA	-0.00845189	0.05808976	-0.145
LNONGSA	-0.0723518	0.05445478	-1.329
STATIOND	-0.143521	0.05439353	-2.639
UNITD	0.03548238	0.04015802	0.884
LRECRUIT	-0.0049711	0.01807104	-0.275
POINTS	-0.0157583	0.03428748	-0.460
LQMA	0.0778431	0.06352346	1.225
LUEMP	-0.0237464	0.05047048	-0.471
LPCPRES	0.002179702	0.004644936	0.469
QD1	0.02600313	0.04175101	0.623
QD2	-0.00800678	0.04306834	-0.186
QD3	0.04461473	0.03752808	1.189
YRD	0.13695381	0.04620827	2.964

MOS 13F simultaneous regression results on enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.34435076	0.0129941	26.501
LPACF	-0.4428	0.06136391	-7.216
LPEB	0.44279977	0.06136391	7.216
LY1	-0.0700374	0.004076215	-17.182
LY2	0.001751243	0.004024402	0.435
LY3	0.06201481	0.004069471	15.239

Table 14. MOS 19X regression results-10 qtrs.
total cost

SYSTEM WEIGHTED MSE IS 1.4793 WITH 1015 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.851718

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEPT	1.43550817	0.31251713	4.593
LY1	0.32891668	0.01256299	26.181
LY2	0.28561719	0.01433283	19.927
LY3	0.33065425	0.01120972	29.497
LPEB	0.49541626	0.05163983	9.594
LPACF	0.50458374	0.05163983	9.771
LY1SQ	0.12273350	0.00635441	19.315
LY2SQ	0.09221809	0.007092227	13.003
LY3SQ	0.12312473	0.005768215	21.345
LY1Y2	-0.0147632	0.001726402	-8.551
LY1Y3	-0.0235897	0.0025442	-9.272
LY2Y3	-0.0200199	0.002147386	-9.323
LPACFSQ	0.40397580	0.0161448	25.022
LPEBSQ	0.40397580	0.0161448	25.022
LPAPEB	-0.403976	0.0161448	-25.022
LPAY1	0.05722644	0.003326585	17.203
LPAY2	-0.0128739	0.002722634	-4.728
LPAY3	-0.0439127	0.004058104	-10.821
LPEBY1	-0.0572264	0.003326585	-17.203
LPEBY2	0.01287389	0.002722634	4.728
LPEBY3	0.04391268	0.004058104	10.821
LOTHGSA	-0.0562835	0.04475891	-1.257
LNONGSA	-0.0332487	0.03919237	-0.848
STATIOND	-0.0518745	0.03658496	-1.418
UNITD	0.005257229	0.03243982	0.162
LRECRUIT	0.02307818	0.01308136	1.764
POINTS	0.007004595	0.04465488	0.157
LQMA	0.08451231	0.04454094	1.673
LUNEMP	0.00451114	0.0380673	0.119
LPCPRES	-0.00523285	0.003781985	-1.384
QD1	0.03403387	0.03708125	0.918
QD2	-0.0456405	0.03459405	-1.319
QD3	0.01659465	0.03547517	0.468
YRD86	0.04923501	0.06883512	0.715

MOS 19X regression results-10 qtrs.
enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.38880415	0.00827136	47.007
LPACF	-0.403976	0.0161448	-25.022
LPEB	0.40397580	0.0161448	25.022
LY1	-0.0572264	0.003326585	-17.203
LY2	0.01287389	0.002722634	4.728
LY3	0.04391268	0.004058104	10.821

Table 15. MOS 19K/19X simultaneous regression results on total cost (8 qtrs.)

SYSTEM WEIGHTED MSE IS 1.16776 WITH 803 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.847402

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	1.3193886	0.37111730	3.555
LY1	0.33170346	0.01559082	21.276
LY2	0.28786337	0.01750958	16.440
LY3	0.32597694	0.01389847	23.454
LPEB	0.46919359	0.06033582	7.776
LPACF	0.53080641	0.06033582	8.798
LY1SQ	0.12669406	1.007951083	15.934
LY2SQ	0.09490603	0.008644046	10.979
LY3SQ	0.12168088	0.007048327	17.264
LY1Y2	-0.0151694	0.002019086	-7.513
LY1Y3	-0.0227915	0.002949812	-7.726
LY2Y3	-0.0196455	0.002379158	-8.257
LPACFSQ	0.40423999	0.01650134	24.497
LPEBSQ	0.40423999	0.01650134	24.497
LPAPEB	-0.40424	0.01650134	-24.497
LPAY1	0.05605034	0.003725135	15.047
LPAY2	-0.0135984	0.002979075	-4.565
LPAY3	-0.0423557	0.004300358	-9.849
LPEBY1	-0.0560503	0.003725135	-15.047
LPEBY2	0.0135984	0.002979075	4.565
LPEBY3	0.04235569	0.004300358	9.849
LOTHGSA	-0.0274426	0.05460056	-0.503
LNONGSA	-0.0434882	0.04814584	-0.903
STATIOND	-0.0522424	0.04022381	-1.299
UNITD	0.004909885	0.03526239	0.139
LRECRUIT	0.02002519	0.01408361	1.422
POINTS	0.01446007	0.05868721	0.246
LQMA	0.08478646	0.0536766	1.580
LUNEMP	0.01375491	0.04510637	0.305
LPCPRES	-0.00437677	0.004145118	-1.056
QD1	0.04542041	0.05406688	0.840
QD2	-0.0891113	0.04110793	-2.168
QD3	0.009405308	0.04162453	0.226
YRD	0.08806878	0.08073902	1.091

MOS 19K/19X simultaneous regression results on enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.39213559	0.009190337	42.668
LPACF	-0.40424	0.01650134	-24.497
LPEB	0.40423999	0.01650134	24.497
LY1	-0.0560503	0.003725135	-15.047
LY2	0.0135984	0.002979075	4.565
LY3	0.04235569	0.004300358	9.849

Table 16. MOS 888* regression results-10 qtrs. total cost

SYSTEM WEIGHTED MSE IS 1.05331 WITH 1041 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.743078

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER-0
INTERCEP	0.26471222	0.42777774	0.619
LY1	0.31718328	0.02217595	14.303
LY2	0.22564130	0.01731153	13.034
LY3	0.31188172	0.01826371	17.077
LOTHGSA	0.006185326	0.06676367	0.093
LPEB	0.23402045	0.05764944	04.059
LPACF	0.76598955	0.05764944	13.287
LY1SQ	0.08191519	0.007929613	10.330
LY2SQ	0.09081295	0.007413544	12.250
LY3SQ	0.11487786	0.009495684	12.098
LY1Y2	-0.0115462	0.00390402	-2.958
LY1Y3	-0.0430764	0.009587115	-4.493
LY.Y3	-0.0153564	0.007171178	-2.141
LPACFSQ	0.35997810	0.01753297	20.531
LPEBSQ	0.35997810	0.01753297	20.531
LPAPEB	-0.359978	0.01753297	-20.531
LPAY1	0.03479658	0.003831304	9.082
LPAY2	0.03574917	0.004339746	8.238
LPAY3	-0.0863142	0.007154981	-12.064
LPEBY1	-0.0347966	0.003831304	-9.082
LPEBY2	-0.0357492	0.004339746	-8.238
LPEBY3	0.08631417	0.008154981	12.064
LNONGSA	0.04749269	0.05386399	0.882
STATIOND	0.04094093	0.03424066	1.196
UNITD	-0.00917843	0.03931905	-0.233
LRECRUIT	-0.023557	0.01776991	-1.326
POINTS	0.06675428	0.05493249	1.215
LQMA	0.07331912	0.05984535	1.225
LUNEMP	-0.000255956	0.05047576	-0.005
LPCPRES	0.01533902	0.008725158	1.758
QD1	0.0798909	0.04415708	1.809
QD2	0.12126410	0.04537294	2.673
QD3	0.09976414	0.0417366	2.390
YRD86	0.35087449	0.05412488	6.483

* Aggregation of 23 Small Combat Arms MOSs.

MOS 888 regression results-10 qtrs. enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER-0
INTERCEP	0.21943071	0.01458884	15.041
LPACF	-0.359978	0.01753297	-20.531
LPEB	0.35997810	0.01753297	20.531
LY1	-0.0347966	0.003831304	-9.082
LY2	-0.0357492	0.004339746	-8.238
LY3	0.8631417	0.007154981	12.064

Table 17. MOS 888 simultaneous regression results on total cost (8 qtrs.)

SYSTEM WEIGHTED MSE IS 1.0278 WITH 842 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.763867

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.05789687	0.47834591	0.121
LY1	0.28069889	0.02375509	11.816
LY2	0.24074652	0.01903136	12.650
LY3	0.29423146	0.02003532	14.686
LOTHGSA	0.0409354	0.0746334	0.548
LPEB	0.10107405	0.08010477	1.262
LPACF	0.89892595	0.08010477	11.222
LY1SQ	0.6652907	0.008792631	7.566
LY2SQ	0.08080789	0.00953678	8.471
LY3SQ	0.11045839	0.0104656	10.554
LY1Y2	-0.000128315	0.005278305	-0.024
LY1Y3	-0.0494279	0.01089062	-4.539
LY2Y3	-0.00779405	0.0080805071	-0.964
LPACFSQ	0.41713630	0.0196241	21.256
LPEBSQ	0.41713630	0.0196241	21.256
LPAPEB	-0.417136	0.0196241	-21.256
LPAY1	0.02894682	0.004064643	7.122
LPAY2	0.03432031	0.005989955	5.730
LPAY3	-0.0836171	0.00746028	-11.208
LPEBY1	-0.0289468	0.004064643	-7.122
LPEBY2	-0.0343203	0.005989955	-5.730
LPEBY3	0.08361715	0.00746028	11.208
LNONGSA	0.05687463	0.06111005	0.931
STATIOND	0.0196412	0.036799	0.534
UNITD	-0.018586	0.03910579	-0.475
LRECRUIT	-0.0258101	0.0177438	-1.455
POINTS	0.03119719	0.06243327	0.500
LQMA	0.01805132	0.06675386	0.270
LUNEMP	0.005364296	0.05595044	0.096
LPCPRES	0.02477137	0.008939113	2.771
QD1	0.18281894	0.06008994	3.042
QD2	0.06963618	0.05754956	1.210
QD3	0.12787868	0.04428268	2.888
YRD	0.44152362	0.06484554	6.809

MOS 888 simultaneous regression results on enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.21003575	0.01527358	13.752
LPACF	-0.417136	0.0196241	-21.256
LPEB	0.41713630	0.0196241	21.256
LY1	-0.0289468	0.004064643	-7.122
LY2	-0.0343203	0.00598995	-5.730
LY3	0.08361715	0.00746028	11.208

Table 18. MOS 999* regression results-10 qtrs.
total cost

SYSTEM WEIGHTED MSE IS 1.10814 WITH 1042 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.830684

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	-0.714149	0.88941478	-0.803
LY1	1.13318770	0.21229741	5.338
LY2	0.04819185	0.26533875	0.182
LY3	0.63305068	0.36813995	1.720
LPEB	0.25982913	0.06374013	4.076
LPACF	0.74017087	0.06374013	11.612
LY1SQ	0.01774842	0.02371411	0.748
LY2SQ	-0.258095	0.0593135	-4.351
LY3SQ	0.12700833	0.09839848	1.291
LY1Y2	0.26078186	0.04369657	5.968
LY1Y3	-0.422894	0.05115988	-8.266
LY2YE	0.013117750	0.0703643	1.864
LPACFSQ	0.15494272	0.0152718	10.146
LPEBSQ	0.15494272	0.0152718	10.146
LPAPEB	-0.154943	0.0152718	-10.146
LPAY1	-0.0190902	0.007187759	-2.656
LPAY2	0.09517175	0.009551559	9.964
LPAY3	-0.0686221	0.01038253	-6.609
LPEBY1	0.0190902	0.007187759	2.656
LPEBY2	-0.0951717	0.009551559	-9.964
LPEBY3	0.06862205	0.01038253	6.609
LOTHGSA	0.0536725	0.02390725	2.245
LNONGSA	-0.153736	0.0401067	-3.833
UNITD	0.0352584	0.04648044	0.759
LRECRUIT	-0.0159286	0.0126816	-1.256
POINTS	0.07660834	0.08090587	0.947
LQMA	0.06725938	0.04487616	1.499
LUNEMP	0.013794039	0.03556827	3.878
LPCPRESS	-0.0463803	0.03908002	-1.187
QD1	0.18584387	0.03310214	5.614
QD2	0.14460653	0.02693127	5.369
QD3	0.08100635	0.02889579	2.803
YRD86	0.37424907	0.04274718	8.755

* Aggregation of all non-Combat Arms MOSs.

MOS 999 regression results-10 qtrs.
enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.25934374	0.05225369	4.963
LPACF	-0.154943	0.0152718	-10.146
LPEB	0.15494272	0.0152718	10.146
LY1	0.0190902	0.007187759	2.656
LY2	-0.0951717	0.009551559	-9.964
LY3	0.06862205	0.01038253	6.609

Table 19. MOS 999 simultaneous regression results on total cost (8 qtrs.)

SYSTEM WEIGHTED MSE IS 1.11263 WITH 826 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.836954

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	-1.32175	0.99679686	-1.326
LY1	0.93282709	0.30529076	3.056
LY2	0.31900781	0.38734021	0.824
LY3	0.78229815	0.40764042	1.919
LPEB	0.16713681	0.06858319	2.437
LPACF	0.83286319	0.06858319	12.144
LY1SQ	0.15252591	0.0676212	2.256
LY2SQ	-0.340841	0.09913618	-3.438
LY3SQ	0.19359209	0.11453323	1.689
LY1Y2	0.29560311	0.07277639	4.062
LY1Y3	-0.514516	0.06619267	-7.773
LY2Y3	0.11484441	0.09494309	1.210
LPACFSQ	0.18731862	0.01719703	10.892
LPEBSQ	0.18731862	0.01719703	10.892
LPAPEB	-0.187319	0.01719703	-10.892
LPAY1	-0.0398935	0.008665433	-4.604
LPAY2	0.0628486	0.01131297	5.555
LPAY3	-0.0292068	0.01105615	-2.642
LPEBY1	0.03989353	0.008665433	4.604
LPEBY2	-0.062846	0.01131297	-5.555
LPEBY3	0.02920683	0.01105615	2.642
LOTHGSA	0.04947383	0.02543016	1.945
LNONGSA	-0.223799	0.04222672	-5.300
UNITD	0.02633459	0.04298499	0.613
LRECRUIT	-0.0153724	0.01182704	-1.300
POINTS	0.30214269	0.07833911	3.857
LQMA	0.15177201	0.04755048	3.192
LUNEMP	0.14205999	0.3625554	3.918
LPCPRES	-0.0549792	0.04212819	-1.305
QD1	0.40944655	0.06262315	6.538
QD2	0.15507491	0.03786113	4.096
QD3	0.11427396	0.02905275	3.933
YRD	0.48412333	0.06040883	8.014

MOS 999 simultaneous regression results on total cost

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEPT	0.22091519	0.05323246	4.150
LPACF	-0.187319	0.01719703	-10.892
LPEB	0.18731862	0.01719703	10.892
LY1	0.03989353	0.008665433	4.604
LY2	-0.0628486	0.01131297	-5.555
LY3	0.02920683	0.01105615	2.642

Table 20. MOS 12B model results
total cost (8 qtrs.)

SYSTEM WEIGHTED MSE IS 1.01305 WITH 784 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.776302

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	-0.16929	0.54056548	-0.313
LY1	0.28083365	0.03108303	9.035
LY2	0.34677592	0.02073929	16.721
LY3	0.22157388	0.02637467	8.401
LPEB	0.01802498	0.16160033	0.112
LPACF	0.98197502	0.16160033	6.077
LY1SQ	0.08174111	0.01541525	5.303
LY2SQ	0.14124479	0.00972891	14.518
LY3SQ	0.0596097	0.01375974	4.332
LY1Y2	-0.0225135	0.004605021	-4.889
LY1Y3	-0.0011847	0.0032235	-0.367
LY2Y3	-0.0376347	0.004265404	-8.823
LPACFSQ	0.17343168	0.030554	5.676
LPEBSQ	0.17343168	0.030554	5.676
LPAPEB	-0.173432	0.030554	-5.676
LPAY1	0.004578345	0.003060331	1.496
LPAY2	0.04678769	0.004942631	9.466
LPAY3	-0.0454672	0.00295069	-15.410
LPEBY1	-0.00457834	0.003060331	-1.496
LPEBY2	-0.0467877	0.004942631	-9.466
LPEBY3	0.04546719	0.002950569	15.410
LOTHGSA	0.05488148	0.07927309	0.692
LNONGSA	0.02969811	0.0722933	0.411
STATIOND	-0.21441	0.03908191	-5.486
LRECRUIT	0.00003123879	0.02160073	0.001
POINTS	-0.451253	0.11855036	-3.806
LQMA	-0.0587459	0.07868925	-0.747
LUNEMP	-0.0984291	0.06738921	-1.461
LPCPRES	0.00894949	0.005322877	1.681
QD1	0.06082254	0.07422752	0.819
QD2	0.07051531	0.0639411	1.103
QD3	0.41664277	0.05488056	7.592
YRD	0.66000668	0.07521371	8.775

MOS12B model results
enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.31703819	0.014635	21.667
LPACF	-0.173432	0.030554	-5.676
LPEB	0.17343168	0.030554	5.676
LY1	-0.00457834	0.003060331	-1.496
LY2	-0.0467877	0.004942631	-9.466
LY3	0.04546719	0.002950569	15.410

Table 21. MOS 19D model results
total cost (8 qtrs.)

SYSTEM WEIGHTED MSE IS 1.010657 WITH 740 DEGREES OF FREEDOM
SYSTEM WEIGHTED R-SQUARE IS 0.855274

MODEL: EQ1 JGLS
DEP VARIABLE: LNCOST

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEPT	-0.191732	0.46112806	-0.416
LY1	0.37496360	0.01841899	20.357
LY3	0.030011040	0.0173165	17.331
LPEB	-0.204293	0.13548573	-1.508
LPACF	1.20429296	0.13548573	8.889
LY1SQ	0.13976543	0.009300351	15.028
LY2SQ	0.11666518	0.008901403	13.106
LY3SQ	0.10030972	0.008880981	11.295
LY1Y2	-0.0188287	0.002576806	-7.307
LY1Y3	-0.0229081	0.002646214	-8.657
LY2Y3	-0.0161775	0.002281993	-7.089
LPACFSQ	0.318716474	0.01738696	18.331
LPEBSQ	0.31871674	0.01738696	18.331
LPAPEB	-0.318717	0.01738696	-18.331
LPAY1	0.04169162	0.003590759	11.611
LPAY2	0.0115987	0.003167724	3.662
LPAY3	-0.059616	0.003268388	-18.263
LPEBY1	-0.0416916	0.003590759	-11.611
LPEBY2	-0.0115987	0.003167724	-3.662
LPEBY3	0.05969164	0.003268388	18.263
LOTHGSA	0.0538668	0.06280784	0.858
LNONGSA	0.01833054	0.05758882	0.318
STATIOND	-0.295655	0.04029518	-7.337
UNITD	0.04522381	0.03885454	1.164
LRECRUIT	0.02046536	0.0158164	1.294
POINTS	0.20193290	0.04935853	4.091
LQMA	-0.0790456	0.06254684	-1.264
LUNEMP	-0.0456338	0.05230263	-0.872
LPCPRES	0.004249927	0.004215529	1.008
QD1	0.18767533	0.05415525	3.466
QD2	0.17164378	0.04892724	3.508
YRD	0.54600823	0.13372975	4.083

MOS19D model results
enlistment bonus cost share

MODEL: EQ2 JGLS
DEP VARIABLE: SHREB

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEPT	0.34837064	0.01030033	33.821
LPACF	-0.318717	0.01738696	-18.331
LPEB	0.31871674	0.01738696	18.331
LY1	-0.416916	0.003590759	-11.611
LY2	-0.0115987	0.003167724	-3.662
LY3	0.05969164	0.003268388	18.263

Table 22. Comparison of key estimated regression parameters based on 8 quarters of data vis a vis 10 quarters of data

	Intercept in EB Cost Share Equation Based on 8 Qtrs.	Intercept in EB Cost Share Equation Based on 10 Qtrs.	In Cost Equation: Coefficient of Logarithm of Price of EB, Based on 8 Qtrs.	In Cost Equation: Coefficient of Logarithm of Price of EB, Based on 10 Qtrs.	Recommended Change in EB Share Based on 8 Qtrs.	Recommended Average EB Share over 8 Qtrs.	Actual Average EB Share over 8 Qtrs.	Recommended Change in EB Share Based on 10 Qtrs.	Recommended Avg. EB Share over 10 Qtrs.	Actual Average EB Share over 10 Qtrs.
MOS 11X (Infantry)	.272	.272	.042	.234	23 percentage point drop in avg. EB share recommended	22%	45.4%	4 percentage point drop recommended in EB share	44%	48.4%
MOS 12B (Combat Engineer)	.317	Not Avail.	.018	Not Avail.	13.2 percentage point drop in avg. EB share recommended	0	13.2%	Not Avail.	Not Avail.	10.6*
MOS 13B (Canon Crewman)	.407	.395	.292	.467	11.5 percentage point drop in avg. EB share recommended	57.6%	69.1%	7 percentage point increase in EB share recommended	71.2%	64.2%

*No incentive utilization of any type for quarters 9 and 10.

Table 22. (continued)

	Intercept in EB Cost Share Equation Based on 8 Qtrs.	Intercept in EB Cost Share Equation Based on 10 Qtrs.	In Cost Equation: Coefficient of Logarithm of Price of EB, Based on 8 Qtrs.	In Cost Equation: Coefficient of Logarithm of Price of EB, Based on 10 Qtrs.	Recommended Change in EB share Based on 8 Qtrs.	Recommended Average EB Share over 8 Qtrs.	Actual Average EB Share over 8 Qtrs.	Recommended Change in EB Share Based on 10 Qtrs.	Recommended Avg. EB Share over 10 Qtrs.	Actual Average EB Share over 10 Qtrs.
MOS 13F (Fire Support Specialist)	.344	.336	.073	0	27 percentage point drop in avg. EB recommended	6.8%	33%	33 percentage point drop in avg. EB recommended	1.2%	34.2%
MOS 19D (Cavalry Scout)	.348	Not Avail.	-.20	Not Avail.	24.1 percentage point drop in avg. EB share recommended	0	24.1%	Not Avail.	Not Avail.	19.28%*
MOS 19X/19K (Armor Crewman)	.392	.388	.469	.495	7 percentage point increase recommended in EB cost share	43.6%	36.6%	11 percentage point increase recommended in EB cost share	48.1%	37.1%

*No incentive utilization of any type for quarter 9 and 10.

Table 22. (continued)

	Intercept in EB Cost Share Equation Based on 8 Qtrs.	Intercept in EB Cost Share Equation Based on 10 Qtrs.	In Cost Equation: Coefficient of Logarithm of Price of EB, Based on 8 Qtrs.	In Cost Equation: Coefficient of Logarithm of Price of EB, Based on 10 Qtrs.	Recommended Change in EB Share Based on 8 Qtrs.	Recommended Average EB Share over 8 Qtrs.	Actual Average EB Share over 8 Qtrs.	Recommended Change in EB Share Based on 10 Qtrs.	Recommended Avg. EB Share over 10 Qtrs.	Actual Average EB Share over 10 Qtrs.
Aggregated Remaining Combat Arms MOSs	.21	.219	.10	.234	11 percentage point drop recommended in EB cost share	15.4%	26.4%	1.5 percentage point increase recommended overall in EB cost	28.3%	26.8%
Aggregated non-Combat Arms MOSs	.221	.167	.259	.260	6 percentage point drop recommended in EB cost share	17.9%	23.9%	No change recommended in EB cost share	26.3%	26.3%

"in-sample" data are used to predict the "out-of-sample" performance. However, another aspect of the overall usefulness of the models has to do with how well the revised econometric models, built from the complete 10-quarter data set, predict the performances for the 9th and 10 quarters.

The econometric parameters, estimated by using the data from the 10 quarters, represent a key part of the decision-making logic being turned over to the U.S. Recruiting Command as a final deliverable of this year-long project. These parameters, designed to capture the trade-offs, substitutions, and scale possibilities, are ultimately the decision parameters that the Army will be relying on to aid in the allocation of enlistment incentives. Hence, while these parameters will hopefully be updated as more experience becomes available, it behooves us to discern how well this final set of parameters does in predicting the outcomes for the 9th and 10 quarters. Table 23 contains, by MOS categories, comparisons of the actual performances for the quarters from January 1988 to June 1988 with those from two sets of projections: (1) the projections from the eight-quarter econometric models, (2) the projections from the 10-quarter econometric models.

The last row of table 23 contains the overall assessment of the 10-quarter econometric models if they were applied to all MOSs for all of January-June 1988. In actuality, the total incentive expenditure over the period from January 1988 to June 1988 was $46.173M, with 43.7 percent of that amoun. being spent on the EB mechanism. Using the econometric models built on data from the 10 quarters, the models would have projected a total of $45.263M (or 2 percent less than that actually spent) needed, of which 39.5 percent would have been spent on the EB side. The projection assumes the same levels and mixes of terms of service for the GSA contracts as for each of the MOS

Table 23. Comparison of actual performances with those of projections from 8-quarter and 10-quarter models (same level and mixes of term for GSA contracts, same recruiting environment, same EB and ACF costs per taker, same nonmonetary incentives in place)

MOS	Actual Incentive Costs	Projected Incentive Cost Needed from 8-Qtr. Model	Projected Incentive Cost Needed from 10-Qtr. Model	Actual Share of Total Incentive Expenditures Devoted to EB	Projected Share of Total Incentive Expenditures Devoted to EB (from 8-Qtr. Model)	Projected Share of Total Incentive Expenditures Devoted to EB (from 10-Qtr. Model)
11X (Infantry)						
9th Quarter (Jan.'88-Mar.'88)	$ 7.62M	$ 7.39M	$ 8.24M	55%	28%	50%
10th Quarter (April '88-June '88)	$ 6.83M	$ 4.50M	$ 6.05M	66%	29%	55%
Total of 9th and 10th quarters for 11X	$14.45M	$11.89M	$14.29M (98.9% of actual)	60.2%	28.4%	52.1%
12B (Canon Crewman)						
9th Quarter	$ 1.94M	$ 2.44M	$ 2.17M	48%	39%	55.7%
10th Quarter	$ 1.20M	$ 1.05M	$ 1.21M	40%	35%	52.8%
Total of 9th and 10th quarters for 13B	$ 3.14M	$ 3.48M	$ 3.38M (107.6% of actual)	44.9%	37.9%	54.7%
13F (Fire Support)						
9th Quarter	$ .498M	$ .407M	$ .405M	35%	17%	5.8%
10th Quarter	$ .814M	$ .589M	$ .597M	36%	21%	8.9%
Total of 9th and 10th quarters for 13F	$ 1.312M	$ .996M	$ 1.002M (76.4% of actual)	35.8%	20%	7.6%

Table 23. (continued)

MOS	Actual Incentive Costs	Projected Incentive Cost Needed from 8-Qtr. Model	Projected Incentive Cost Needed from 10-Qtr. Model	Actual Share of Total Incentive Expenditures Devoted to EB	Projected Share of Total Incentive Expenditures Devoted to EB (from 8-Qtr. Model)	Projected Share of Total Incentive Expenditures Devoted to EB (from 10-Qtr. Model)
19K/19X (Armor Crewman)						
9th Quarter	$ 1.662M	$ 1.663M	$ 1.[illegible]78M	43%	45%	48%
10th Quarter	$ 1.333M	$ 1.189M	$ 1.287M	36%	47%	49.2%
Total of 9th and 10th quarters for 19K/19X	$ 2.995M	$ 2.852M	$ 2.965M (99% of actual)	39.8%	45.3%	48.2%
The Aggregate of All Remaining Combat Arms MOSs						
9th Quarter	$ 1.545M	$ 1.99M	$ 1.676M	25%	3%	18.9%
10th Quarter	$ 1.834M	$ 1.365M	$ 1.548M	31%	14%	28.3%
Total for 9th and 10th quarters for remaining Combat Arms MOSs	$ 3.379M	$ 3.355M	$ 3.224M (95.4% of actual)	28.2%	7.5%	23.4%
The Aggregate of All non-Combat Arms MOSs						
9th Quarter	$11.525M	$15.989M	$12.038M	37%	19%	31.4%
10th Quarter	$ 9.372M	$ 9.395M	$ 8.364M	34%	18%	31.6%
Total of 9th and 10th quarters for all Non-Combat Arms MOSs	$20.897M	$25.384M	$20.402M (97.6% of actual)	35.7%	19%	31.5%

Table 23. (concluded)

MOS	Actual Incentive Costs	Projected Incentive Cost Needed from 8-Qtr. Model	Projected Incentive Cost Needed from 10-Qtr. Model	Actual Share of Total Incentive Expenditures Devoted to EB	Projected Share of Total Incentive Expenditures Devoted to EB (from 8-Qtr. Model)	Projected Share of Total Incentive Expenditures Devoted to EB (from 10-Qtr. Model)
All MOSs						
9th Quarter	$24.79M	$29.879M	$26.207M	43%	22.4%	39.1%
10th Quarter	$21.38M	$18.088M	$19.056M	44.5%	24.7%	40.1%
Total of 9th and 10th quarters for all MOSs	$46.173M	$47.962M	$45.263M (98% of actual)	43.7%	23.3%	39.5%

groupings analyzed, the same numbers of non-GSA contracts, the same recruiting environment (i.e., same unemployment rates, QMA, number of recruiters present, etc.), same average EB and ACF awards per taker, and the same application of nonmonetary awards. Note, too, that the degree of fit is also very close for each of the individual MOS groupings. Hence, the Army should be quite confident in using the econometric models (built on 10 quarters) to predict the needed level of incentive expenditures to meet given levels of GSA contracts in postulated recruiting environments.

5.0 ILLUSTRATION OF USE OF MOS BUDGET GENERATION PROGRAM TO SELECT PROPER LEVEL OF EB AWARD

In the validation exercises in Section 3.0, we addressed the following question for a given MOS: Given (1) the actual level and mix of GSA contracts obtained for a given quarter, (2) the actual recruiting environment present (e.g., number of recruiters present, unemployment rate, etc.), (3) the competition effects for GSA contracts from other MOSs and for non-GSA contract requirements, (4) the actual average level of the ACF award per taker, and (5) the actual average level of the EB award per taker, what then is the minimum total incentive cost needed and what should be the fraction of the budget spent on the EB option?

Note that in the validation exercises, it is appropriate to use the actual EB award per taker because we wish to compare the projection of the model's efficient cost with what actually occurred in order to test the reasonableness of the results. However, for future use of the model, say in the POM process, the Army decision makers will need some insights as to the proper level of the EB award by MOS for an upcoming time period, given the numbers and mix of GSA contracts desired, the anticipated recruiting environment, etc. We have earlier noted the actual large variation in the level of the EB award over the 10 quarters (see, for example, table 4 for MOS 11X), the average of which, for 11X, ranged from a low of $2,709 to a high of $4,929, an increase of some 82 percent.

To illustrate the use of the budget model for helping to determine the proper level of the EB award, consider quarter 9 (January-March 1988) for MOS 11X when the actual EB award was at $4,105. The model's projection of the minimum total incentive cost needed at this level of award for 11X was $7.393M, some 3 percent less than the actual of $7.620M. (Incidentally, the average ACF award for this period was $3,195, reflecting the actual mix of 2-, 3-, and 4-year ACF takers for 11X for the 9th quarter.)

Consider now the impact on the total incentive cost needed by varying the level of the EB award (using the actual level as a base) for the 9th quarter for 11X (table 24). The changes are in increments of $500; the level of the ACF award is left unchanged.

Table 24. Impact on total incentive cost needed (for same mix and numbers of GSA contracts) by varying EB award for 11X, quarter 9 (average ACF award unchanged @ $3,1959)

Level of EB award for 9th Qtr.	Total Minimum Incentive Cost Needed (9th Qtr.)	Share of Budget Devoted to EB (9th Qtr.)	Total Number of ACF or EB Takers
$4,105 (actual)	$7.620M (actual)	55% (actual)	2,089 (actual)
$4,105 (actual)	$7.394M (projected)	28% (projected)	2,171 (projected)
$4,605 ($500 above actual level)	$7.461M (projected)	32.8% (projected)	2,100 (projected)
$5,105 ($1,000 above actual level)	$7.553M (projected)	37.3% (projected)	2,033 (projected)
$5,605 ($1,500 above actual level)	$7.659M (projected)	41.4% (projected)	1,971 (projected)
$3,605 ($500 below actual level)	$7.366M (projected)	22.2% (projected)	2,248 (projected)
$3,105 ($1,000 below actual level)	$7.409M (projected)	15.7% (projected)	2,329 (projected)
$2,605 ($1,500 below actual level)	$7.578M (projected)	8% (projected)	2,415 (projected)

We observe that the total incentive budget needed for 11X for the 9th quarter is relatively insensitive to the level of the EB award, varying from a projected low of $7.366M (at the EB level of $3,605 ($500 below the actual of $4,105)) to a high of $7.578M (at an EB level of $2,605 ($1,500 below the actual level)). Hence, given a goal for 11X of 2,807 GSA contracts (with 696 2-year termers, 725 3-year termers, and 1,386 4-year termers), an average unemployment rate of 6.66 percent, 4,206 recruiters in the field, 14,523 GSA contracts required outside MOS 11X, and 12,137 total non-GSA contracts required, one would conclude for the 9th quarter that an average EB level of $3,605 would be preferred (in contrast to the actual of $4,105). Thus, a total incentive budget for MOS 11X of $7.366M (or $2,624 per GSA recruit compared to the actual of $2,703) would be projected, with 22.2 percent of the amount going for the EB option (compared to the actual of 55 percent).

Consider the results of the same exercise for quarter 10 (see table 25) where the total GSA goal for 11X was 2,329 (about 500 less than for the 9th quarter), the average ACF award was $3,202, and the actual EB award was $4,348. Upon repeating the budget projections for different levels of the EB award, it is found that the preferred EB award for MOS 11X for quarter 10 is $3,848 ($500 less than the actual), with 23.7 percent of the total amount being allocated to the EB option (rather than the actual of 66 percent). The software being delivered to USAREC will automatically cycle through six levels of EB awards, in $500 increments (and decrements) from the inputted EB award level. The user can then determine which EB award level he wishes to use. By changing the inputted (base) EB level, the user of the software can search a large number of possibilities.

Table 25. Impact on total incentive cost needed (for same mix and numbers of GSA contracts) by varying EB level for 11X, quarter 10 (average ACF award unchanged @ $3,202)

Level of EB Award for 10th Qtr.	Total Minimum Incentive Costs Needed (10th Qtr.)	Share of Budget Devoted to EB 10th Qtr.	Total Number of ACF or EB Takers
$4,348 (actual)	$6.830M (actual)	66% (actual)	1,766 (actual)
$4,343 (actual)	$4.499M (projected)	29% (projected)	1,297 (projected)
$4,848 ($500 above actual level)	$4.542M (projected)	34% (projected)	1,256 (projected)
$5,348 ($1,000 above actual level)	$4.598M (projected)	38% (projected)	1,217 (projected)
$5,848 ($1,500 above actual level)	$4.661M (projected)	42% (projected)	1,179 (projected)
$3,848 ($500 below actual level)	$4.475M (projected)	24% (projected)	1,342 (projected)
$3,348 (1,00 below actual level)	$4.485M (projected)	18% (projected	1,390 (projected)
$2,848 ($1,500 below actual level)	$4.554M (projected)	11% (projected)	1,441 (projected)

6.0 TO IMPACT OF USING DIFFERENT ACTUARIAL ESTIMATES ON COST OF ACF PER TAKER

All of the previous analyses have been based on the DOD actuarial cost estimates for the ACF that were in place at the time of the initiation of this study, (October 1988). These estimates were: $2,888 for each 2-year ACF taker; $3,750 for each 3-year ACF taker; and $3,895 for each 4-year ACF taker. Based on more recent experience, the Army Research Institute (ARI) has recently completed an analysis of the actuarial costs of each of these types of takers to determine what fraction of the recruits receiving the awards will actually utilize them, when, etc. As a result of the Institute's findings, the estimates were revised: $2,652 for each 2-year ACF taker (down from $2,888), $1,618 for each 3-year ACF taker (down from $3,750), and $1,152 for each 4-year ACF taker (down from $3,895). Additionally, the Department of Defense recently lowered the weighted actuarial cost of the ACF award to approximately 55 percent of its previous value.

We were interested in seeing how the incentive cost projections would vary if the ACF cost estimates by the ARI were used in the budget projection software. The key caveat to such an exercise is that the regression analysis (on which the budget projections are based) must utilize the higher actuarial estimates of the ACF that were in effect in October 1988. Thus, because there was no experience included in the regression cells for the types of prices associated with the ARI estimates, any extrapolations have to be viewed very cautiously and tentatively.

Before looking at the results, we intuitively note that with the lower per unit ACF prices, we would expect the total incentive budget to be substantially low. We also might expect less utilization of the ACF mechanism, because its perceived value is less. Consider the results with a new weighted ACF price per taker of $2,249[9] (compared to $3,195) for quarter 9 and $2,230[10] (compared to $3,202) for quarter 10 (see table 26). (These weighted prices were obtained by assuming the same proportions of 2-, 3-, and 4-year takers of the ACF as

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9. This number would be $1,757 if costs were lowered 45 percent across the board.

10. This number would be $1,761 if costs were lowered 45 percent across the board.

actually occurred in the 9th and 10th quarters for 11X: namely 65 percent, 26 percent, and 9 percent respectively, for the 9th quarter; and 66 percent, 19 percent, and 15 percent, respectively, for the 10th quarter.)

Table 26. Impact of varying ACF actuarial cost

Quarter	Level of ACF Award per Taker	Level of EB Award per Taker	Total Incentive Cost	Number of EB Takers	Number of ACF Takers
9	$3,195 (actual based on DOD estimates of actuarial cost in Oct., 1988)	$4,105 (actual)	$7.620M (actual)	1,026	1,063
9	$3,195 (actual based on DOD estimates in Oct., 1988)	$4,105 (actual)	$7.394M (projected)	501	1,670
9	$2,249 (actual based on ARI actuarial cost estimates)	$4,105 (actual)	$5.427M (projected)	570	1,372
10	$3,202 (actual based on DOD estimates in Oct., 1988)	$4,348 (actual)	$6.83M (actual)	1,029	737
10	$3,2[illegible] (actual based DOD estimates in Oct., 1988)	$4,348 (actual)	$4.499M (projected)	300	997
10	$2,230 (actual based on ARI actuarial cost estimates)	$4,348 (actual)	$3.282M (projected)	338	813

We observe that the optimizing budget is indeed less, i.e., $5.427M versus $7.39M for quarter 9, when a drop in the ACF price of $946 is assumed. Also, as perhaps expected, given the manner in which the regression was built, the lower per unit ACF cost gives rise to a projected lower number of ACF takers (i.e., 1,372 compared to 1,670) because, with the lower perceived value for the ACF award, the model assumes that more recruits would prefer the EB.

We conclude this brief excursion by stating that we feel the model, in its present form, should not be used to study the allocations to be made if the actuarial costs associated with the ACF have indeed changed drastically. We argue this because the model was built on costing out the ACF mechanism at the DOD actuarial cost estimates in force in October 1988. We point out, however, that the regressions, by MOS, could be reestimated straightforwardly by using the same 10 quarters of data but employing altered estimates for the ACF costs. These changes could then be included in the PC Budget Projection Software for use in preparing future budget requests and in executing given budgets.

7.0 POSSIBLE ENHANCEMENTS

The following is a brief list of possible enhancements to the budget generation models produced by this project:

i) DOD has recently approved a sharp reduction (in the order of 45 percent) in the dollar amounts required to be escrowed for each ACF taker. Such a reduction changes drastically the relative cost-effectiveness of the ACF incentive vis a vis an enlistment bonus of a given size. If USAREC wishes to use the budget generation model in the context of this reduction in the price of the ACF, should reestimate the parameters of the decision-making logic using the lower ACF costs. This would not be an expensive or time-consuming task because the database (on the number of takers obtained, the recruiting environment, etc.) is already in place, as are the estimation techniques.

ii) After June 1988, USAREC was no longer allowed to award the ACF incentive for GSA contracts in MOSs outside the Combat Arms MOSs. What has been the impact of this decision on the supply of GSA recruits in the other MOSs? We recall that over the previous two quarters (i.e., January 1988-June 1988), 11,835 GSA contracts were obtained in the non-Combat Arms MOSs at a total cost of $11.525M, or about $958 per GSA contract. Also, of these 11,835 contracts, 1,212 received the 3-year ACF and 705 received the 4-year ACF. (Incidentally, 1,204 received the EB benefit at an average level of $3,917.) With additional experience from quarters beyond June 1988, the models could be reestimated and new lessons learned.

iii) Many of the nonmonetary incentives (i.e., the 2-year term, unit of choice, station of choice, etc.) as well as guidance counselor incentives have been applied only in concert with the monetary incentives. For example, in the past, where a MOS is prioritized so that guidance counselors receive their own set of rewards if the MOS is sold off the first three screens (i.e., the first 15 slots presented to a recruit), the monetary incentives have also been applied. Are both monetary and guidance counselor incentives necessary? Could the quotas have been met with just the application of the guidance counselor incentives? In order to answer these and other questions, it would be highly desirable to conduct controlled experiments in selected test cells and to analyze the results of those tests.

iv) There is some interest in possibly changing the advertised value of the ACF, currently at $17,000 for a 2-year ACF taker, $22,800 for a 3-year ACF taker, and $25,200 for a 4-year ACF taker. What would be the impact of such a change on the market-expansion capability of the ACF if this were done? One way to obtain some insights into this question would be to rerun the econometric models, but with a new variable for the advertised value or benefit of the ACF. That is, in addition to the present variable, which captures the actuarial value of the ACF, we could include a variable that captures the advertised value of the ACF. By reestimating the equations by MOS, one could estimate the elasticity on supply of a change in the ACF advertised value. This could be an important justification for such a request.

v) The models could be enhanced by including other demographics and Army resources that were not available at the time of this study. These include the level of Army advertising, level of joint DOD advertising, military/civilian pay ratios, the number of GSA eligibles in the population, size and mix of Delayed Entry Program, etc. Presently, because the models include the level of recruiters, one can determine what additional enlistment incentives might be needed as recruiters are reduced or some other factor concerning the level of recruiters is changed. The same types of trade-offs are possible for other Army recruiting resources and demographics.

vi) In addition to the ACF and EB, other types of monetary incentives presently being utilized, such as the Federal Loan Repayment Program, could be included.

The above are representative of the powerful extensions possible with this new tool. When one appreciates the amount of money involved in the use of incentives (e.g., \$1.17 billion dollars spent over FY81-FY86), a level much higher than the expenditure for all Army advertising during the same period, it behooves the Army to better understand the dynamics and complex interactions of incentives. Such a capability will be of enormous aid in building and defending budget requests in the future and in executing present allotments.

APPENDIX

8.0 APPENDIX

A. The Enlistment Incentive Cost Allocation Model

The model described herein serves two related purposes: descriptive and predictive. As a descriptive tool, it is designed to explain the observed pattern of incentive cost and its allocation within a MOS, to identify any departures of the observed pattern from efficient incentive cost and its allocation within that MOS, and to quantify the cost of such departures, if any have occurred. The "observed" pattern of incentive cost and its allocation refers to historical data by quarter and by recruiting battalion for the period CY86-CY87 for each of eight MOS groupings. For each MOS grouping, the observed data consist of 8*54=432 observations capturing both temporal and geographical experience.

More importantly, the model serves a predictive purpose, since it is capable of projecting out-of-sample values of incentive cost and its allocation. The projection can be based on a continuation of the incentive cost and its allocation observed within the sample; it can also be based on a continuation of the efficient incentive cost and its allocation generated from observed sample data in a manner to be described below. The latter projection, of efficient behavior, is of primary interest.

The model consists of three equations, an incentive-cost equation and a pair of equations expressing the allocation of incentive cost to its two component categories, the enlistment bonus (EB) and the Army College Fund (ACF). A minimum incentive-cost equation for a particular MOS can be written:

$$C = C(Y1, Y2, Y3, Y4, Y5, P1, P2, N1, N2, Z1, Z2, Z3, Z4, Z5, Q1, Q2, Q3, T) \qquad (1)$$

where variables are defined as follows:

Variable	Acronym	Definition
C	Cost	Total incentive cost in the MOS
Y1	Y1	Number of 2-year contracts
Y2	Y2	Number of 3-year contracts
Y3	Y3	Number of contracts longer than 3 years
Y4	OTHGSA	Number of GSA contracts in other MOSs
Y5	NONGSA	Number of non-GSA contracts in all MOSs
P1	PEB	Price of index for EB option
P2	PACF	Price of index for ACF option
N1	STATIOND	Dummy variable for station of choice option (-1 if available)
N2	UNITD	Dummy variable for unit of choice option (-1 if available)
Z1	POINTS	Dummy variable for availability of guidance counselor points for selling the MOS (-1 if yes)
Z2	RECRUIT	Number of recruiters
Z3	QMA	Size of military eligible population
Z4	UNEMP	Unemployment rate in battalion area
Z5	PCPRES	Percentage of time the MOS appeared on the first three screens
Q1	QD1	Dummy variable for first quarter of CY
Q2	QD2	Dummy variable for second quarter of CY

Q3	QD3	Dummy variable for third quarter of CY
T	YRD	Dummy variable for CY86
S1	SHREB	P1X1/C - share of EB option in cost
S2	SHRACF	P2X2/C - 1 - S1 - share of ACF option in cost
X1	EB	Number of takers of the EB option
X2	ACF	Number of takers of the ACF option

For this model to be applied empirically, it is necessary to endow the minimum incentive cost equation with functional structure, and to specify an estimation technique. The structure should be sufficiently flexible so as to impose no properties on recruiting technology that are unwarranted by the data. It should also be sufficiently simple so as to be tractable empirically in light of the size of the database relative to the number of included explanatory variables.

A flexible second-order logarithmic specification, dubbed "translog," is attractive because comparative static effects are easily represented by elasticities, which facilitate comparisons across different experiments. The translog incentive-cost equation for a MOS is written as:

$$\ln C(.) = ao + \sum_{i=1}^{3} ai\ln Yi + a4\ln Y4 + a5\ln Y5 + \sum_{i=1}^{2} bi\ln Pi$$

$$+ 1/2 \sum_{i=1}^{3}\sum_{j=1}^{3} aij\ln Yi\ln Yj + 1/2 \sum_{i=1}^{2}\sum_{j=1}^{2} bij\ln Pi\ln Pj$$

$$+ \sum_{i=1}^{3}\sum_{j=1}^{2} gij\ln Yi\ln Pj + \sum_{i=1}^{2} diNi \quad e1Z1$$

$$+ \sum_{i=2}^{5} ei\ln Zi + \sum_{i=1}^{3} qiQi + tT \qquad (2)$$

Note that (2) is log-quadratic in (Y1, Y2, Y3, P1, P2) and log-linear or linear in the remaining variables. Thus, total incentive cost in a MOS is influenced primarily by the number and length of term of enlistments desired in that MOS, by the cost of each of the two monetary incentives, and also by a host of other variables, some of which are Army policy variables and others of which characterize the environment in which recruiting takes place.

It is possible to estimate (2) by itself. However, in order to improve efficiency in estimation, we add a set of subsidiary equations to (2). A fundamental result in mathematical programming states that the effect on the optimal value of the objective function of a slight relaxation of a constraint is equal to the optimal value of the endogenous variable whose constraint is relaxed. In the present context, this result means that the effect on minimized incentive cost of a change in the unit cost of an incentive equals the optimal utilization of the incentive whose unit cost changes. Since the minimum incentive-cost function in (2) is logarithmic, this result means that the fraction of total incentive cost for a MOS that should be allocated to the i-th monetary incentive is given by:

$$\begin{aligned} Si(.) &= d\ln C(.)/d\ln Pi \\ &= bi + \sum_{j=1}^{2} bij\ln Pj + \sum_{j=1}^{3} gji\ln Yj, \quad i=1,2 \end{aligned} \qquad (3)$$

where the parameters of (3) are the same as those of (2).

The system (2), (3) describes the determination of efficient incentive allocation $Si(.)=PiXi/C$, $i=1,2$, and its cost $C=P1X1+P2X2$.

The next problem is to rewrite the system (2), (3) in terms of observed, possibly inefficient, incentive allocation and its cost. Solution of this problem not only provides a model suitable for estimation, it also generates measures of the direction, magnitude, and cost of inefficient incentive allocation. We begin by rewriting (2), (3) in terms of observed values of incentive cost and its allocation in a MOS as:

$$
\begin{aligned}
\ln C = {} & ao + \sum_{i=1}^{3} ai\ln Yi + a4\ln Y4 + a5\ln Y5 + \sum_{i=1}^{2} bi\ln Pi \\
& + 1/2 \sum_{i=1}^{3} \sum_{j=1}^{3} aij\ln Yi\ln Yj + 1/2 \sum_{i=1}^{2} \sum_{j=1}^{2} bij\ln Pi\ln Pj \\
& + \sum_{i=1}^{3} \sum_{j=1}^{2} gij\ln Yi\ln Pj + \sum_{i=1}^{2} diNi + e1Z1 \\
& + \sum_{i=2} ei\ln Zi + \sum_{i=1}^{3} qiQi + tT + uo
\end{aligned}
\qquad (4)
$$

$$
Si = bi + \sum_{j=1}^{2} bij\ln Pj + \sum_{j=1}^{3} gji\ln Yj + ui, \quad i=1,2 \qquad (5)
$$

The left sides of (4), (5) are observed values of incentive cost and its allocation. The right sides, exclusive of the error terms uo and ui, are seen from (2), (3) to be the efficient values of incentive costs and its allocation. The error terms represent the differences between the two, these differences being attributable to both inefficiencies in the incentive allocation process and the noise that appears in all such empirical relationships.

We allow for allocative inefficiencies by assuming that

$E(u_i) = \theta_i \gtrless 0$, $i=1,2$, so that incentive X_i can be systematically overutilized ($\theta_i > 0$), efficiently utilized ($\theta_i = 0$), or systematically underutilized ($\theta_i < 0$). Since even inefficient shares sum to unity, $\theta_1 + \theta_2 = 0$. Because the cost of allocative inefficiency is nonnegative, the systematic component of u_o, call it θ_o, is nonnegative. The easiest way to estimate (4), 5) is to merge the systematic allocative inefficiencies θ_i with their respective intercepts b_i, and merge the cost of the allocative inefficiencies θ_o with the cost equation intercept a_o, to get the system:

$$
\begin{aligned}
\ln C = {} & (a_0+\theta_0) + \sum_{i=1}^{3} a_i \ln Y_i + a_4 \ln Y_4 + a_5 \ln Y_5 + \sum_{i=1}^{2} b_i \ln P_i \\
& + 1/2 \sum_{i=1}^{3} \sum_{j=1}^{3} a_{ij} \ln Y_i \ln Y_j + 1/2 \sum_{i=1}^{2} \sum_{j=1}^{2} b_{ij} \ln P_i \ln P_j \\
& + \sum_{i=1}^{3} \sum_{j=1}^{2} g_{ij} \ln Y_i \ln P_j + \sum_{i=1}^{2} d_i N_i + e_1 Z_1 \\
& + \sum_{i=2}^{5} e_i \ln Z_i + \sum_{i=1}^{3} q_i Q_i + rt + (u_0-\theta_0)
\end{aligned}
\tag{6}
$$

$$
S_i = (b_i+\theta_i) + \sum_{j=1}^{2} b_{ij} \ln P_j + \sum_{j=1}^{3} g_{ji} \ln Y_j + (u_i-\theta_i), \quad i=1,2 \tag{7}
$$

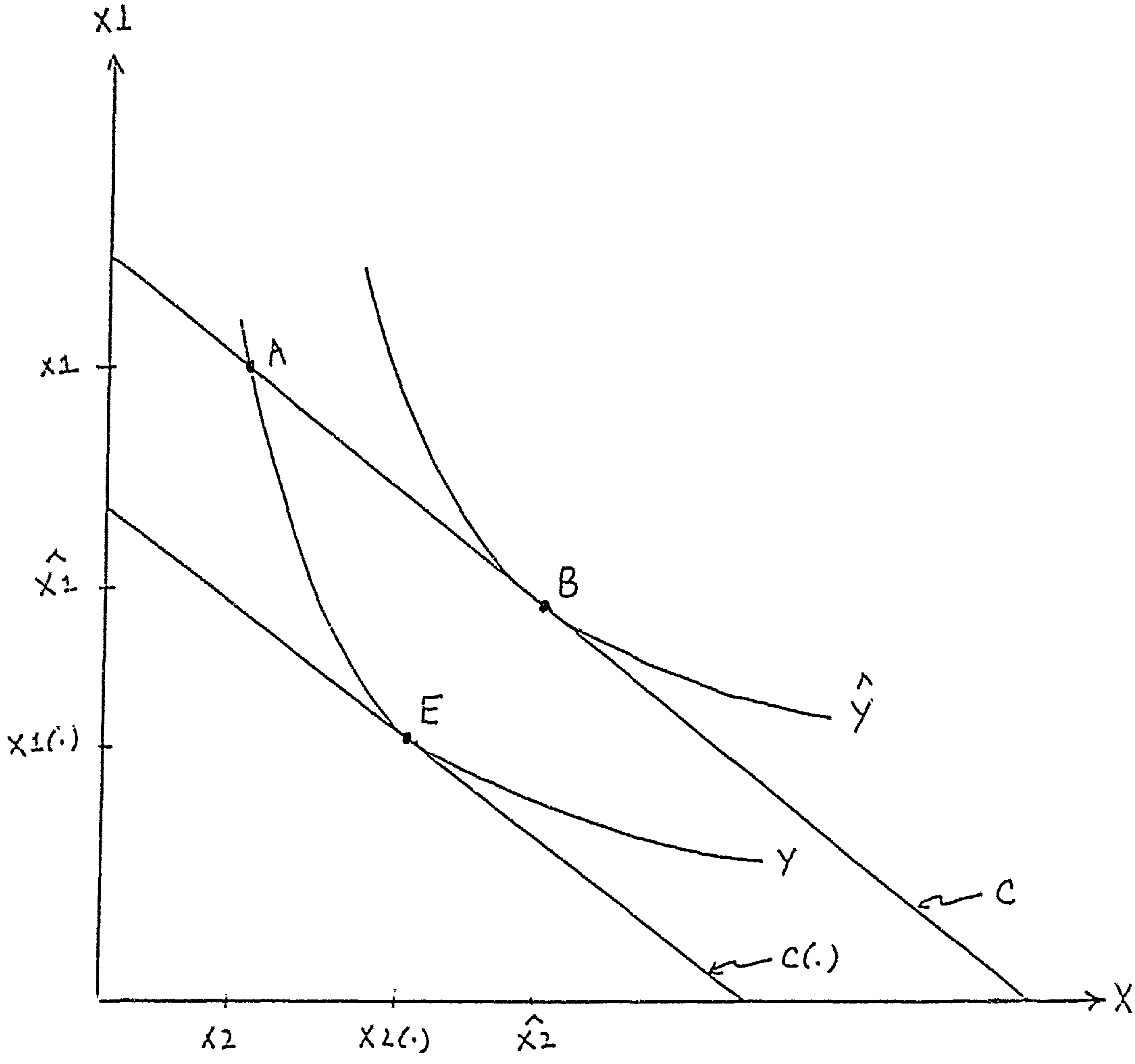
Note, that now $E(u_o - \theta_o) = E(u_i - \theta_i) = 0$, $i=1,2$. We can now evaluate the efficiency of incentive allocation, with the help of equations (6), (7) and figure 2. Observed incentive cost shares are given by the left sides of (7). Observed incentive usage (X_1,X_2) is located at point A in figure 2; the cost of this allocation is C, and it generates Y ($=Y_1+Y_2+Y_3$) contracts. Estimated incentive cost shares are given by the right sides of (7).

Estimated allocative inefficiencies θi are obtained by subtracting the estimates of the bi obtained from (6) from the estimated intercepts of (7). Estimated efficient cost shares are obtained by subtracting the θi from the right sides of (7). From these estimated efficient incentive cost shares estimated efficient incentive usages for observed expenditure level C are obtained as $\hat{X}i = (C/Pi)$*(estimated efficient incentive cost share), $i=1,2$.

In figure 2 the efficient way to allocate observed expenditure C is indicated by $(\hat{X}1,\hat{X}2)$, located at point B. This efficient allocation of incentives generates more contracts $(\hat{Y}>Y)$ from the same expenditure C. One measure of the efficiency of incentive allocation is $(Y/\hat{Y})$, the ratio of observed to maximum contracts obtained from observed incentive expenditure. However, we have modeled the Army as trying to minimize the cost of meeting recruiting goals. In this case, the same efficiency ratio $(Y/\hat{Y})$ can be applied to observed expenditure to obtain an equivalent measure to the efficiency of incentive allocation, namely, the ratio of minimum to observed incentive expenditure required to obtain observed contracts Y. Thus, $(Y/\hat{Y})$ (C) = C(.) is the smallest incentive budget capable of generating observed contracts Y in a given recruiting environment, and this minimum cost requires efficient incentive usages X1(.) and X2(.).

In figure 2 the efficient way to generate observed contracts Y is located at point E, where C(.) is allocated efficiently to X1(.) and X2(.). This finally enables us to obtain an estimate of θo via $\theta o = \ln(c/C(.))$, thereby providing a complete comparison of observed and estimated efficient values of incentive cost shares, incentive usages, and incentive cost. The technique works, in the sense that it is able to generate efficient behavior from observed possibly inefficient data, by generating separate estimates of

Figure 2. The Efficiency of Incentive Allocation



the parameters describing recruiting technology and the parameters describing over- or underutilization of monetary incentives relative to the costs of using those incentives.

Equations (6), (7) constitute a system of three equations, a cost equation and two incentive cost-share equations. However, since incentive cost shares sum to unity, one cost-share equation is redundant, leaving two independent equations to be estimated. Parameters in the deleted incentive cost-share equation are obtained from the following "adding-up" restrictions:

$$\begin{aligned} b1 + b2 &= 1 \\ b11 + b21 &= 0 \\ b12 + b22 &= 0 \\ g11 + g12 &= 0 \\ g21 + g22 &= 0 \\ g31 + g32 &= 0 \end{aligned} \tag{8}$$

Writing the system (6), (7) in compact form, we have:

$$Y = XB + e$$

where Y is a vector of observed dependent variables, X is a matrix of explanatory variables, B is a parameter vector constrained by (8) to be estimated, and 3 is a disturbance vector. The disturbance vector is assumed to satisfy:

$$E(e) = 0$$

$$E(ee') = \Sigma \otimes I$$

where $\otimes$ denotes the Kronecker product and $\Sigma = (\sigma ij)$ is a 2*2 symmetric and positive definite matrix. Nonzero off-diagonal elements of Σ signal correlated disturbances across equations, and suggest that the equations in the system are only "seemingly unrelated," being related through their disturbances terms, perhaps as a consequence of omitted variables.

The parameters of the system can, as noted above, be estimated by ordinary least squares applied to each equation separately. Under assumptions (10), the parameter estimates are unbiased (apart from the cost-equation intercept) and consistent. They are not efficient, however, because they ignore the interdependence among equations caused by correlated disturbances. A systems estimator is called for. Several are available, the most popular of which is Zellner's "seemingly unrelated regressions" technique. In this two-step method, each equation is estimated separately by ordinary least squares, after which the ordinary least squares residuals are used to form a consistent estimator $\tilde{\Sigma}$ of Σ. Second-stage parameter estimates based on $\tilde{\Sigma}$ are unbiased (again apart from the cost-equation intercept, which is biased upward), consistent, and asymptotically efficient. Estimation of the model is carried out using PROC SYSLIN on SAS.

After estimation, an internal consistency check is performed. The check is designed to prevent the estimation of the efficient incentive shares that are neither negative or greater than unity. Refer to estimating equations (6) and (7). Although observed incentive cost shares are bounded by zero and one, the adjustments to estimated shares required to create estimated efficient shares can force estimated efficient shares outside the unit interval. This is most likely to happen when observed shares are close to zero or unity. The consistency check simply adjusts the estimated efficient share up to zero or down to unity by increasing or reducing the efficient share intercept bi up or down by the appropriate amount. The cross-equation parameter restriction forces the same parameter in the estimated efficient cost equation, and hence estimated efficient total cost, to be adjusted at the same time. Estimated efficient incentive usage is also automatically adjusted; whenever an estimated efficient share is adjusted up to zero or down to one, the corresponding efficient incentive usage is adjusted up to zero or down to total efficient incentive usage. In all instances where such adjustments have been made, they have been quantitatively small.